nature-based urban innovation

NATURVATION

project

CITY FOR BIODIVERSITY: THE ROLES OF NATURE-BASED SOLUTIONS IN EUROPEAN CITIES

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Led by Durham University, NATURVATION involves 14 institutions across Europe working in fields as diverse as urban development, innovation studies, geography, ecology, environmental assessment and economics. Our partnership includes city governments, non-governmental organisations and business. We will assess what nature-based solutions can achieve in cities, examine how innovation is taking place, and work with communities and stakeholders to develop the knowledge and tools required to realise the potential of nature-based solutions for meeting urban sustainability goals.

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EXECUTIVE SUMMARY

This report summarises the first analysis of nature-based solutions (NBS) across European cities in terms of their contributions to biodiversity goals. Drawing on a sample of 199 nature-based solutions from the Urban Nature Atlas[1] established by NATURVATION, which mainly involved three types of urban settings (i.e. large urban parks and forests, rivers/streams/estuaries, and community gardens), we identify how cities work with NBS to *conserve* nature, *restore* nature, and to *thrive* through harnessing nature's contribution to people.

Our findings show that cities are making explicit contributions to biodiversity through NBS, but that this agenda is yet to be fully integrated in the implementation of NBS and that there is significant variation in the ways in which such goals and actions are being pursued. First, with only a little over a third of NBS included in the Urban Nature Atlas (351 out of 976) have explicit biodiversity goals and actions in their design and implementation, it is clear that there is significant missed opportunity for addressing biodiversity at the urban level as cities increasingly engage with NBS. Second, we find that the form that NBS take plays a significant role to the varied biodiversity goals that are pursued. NBS that work with nature in urban parks and community gardens focused primarily on conservation and thriving with nature (through mobilising nature's contribution to people), with much less attention given to goals for restoration. In contrast, where NBS involve urban rivers/streams/estuaries, restoration had received a relatively similar level of emphasis to conservation and thriving. Third, across all types of intervention, it is found that their biodiversity goals and explicit implementation actions were primarily ecosystem-based, focusing on the protection, restoration or enhancement of the integrity, functionality, and connectivity of habitats and ecosystems. In general, there were fewer species-based NBS projects amongst our sample, and very few projects concerned with conserving or restoring genetic diversity. Finally, further examination of the detailed goals and explicit actions of the projects included in this analysis found that a number of NBS projects adopted quantitative targets to guide their implementation, such as number of trees to be planted, area of green or blue areas to be created or restored, number of green areas to be (re)created, number of species to be protected or reintroduced, and number of jobs to be created. European cities are therefore taking project-based actions for biodiversity through a set of explicit, quantitative and measurable targets, which are tailored to the specific conditions of urban settings.

On the basis of these findings, this report suggests that: (a) it is important to recognise the roles cities are (and can be) playing in the global biodiversity agenda; (b) that there is a need to ensure that

[1] http://naturvation.eu/atlas

biodiversity goals are more widely included in urban NBS by designing and supporting pathways for mainstreaming NBS which ensure biodiversity challenges are taken into account; (c) that there is currently a missed opportunity to take issues of biodiversity restoration and genetic diversity into account when elaborating biodiversity strategies and designing and implementing NBS in cities; and (d) last but not least, that if cities are to achieve ambitious goals for biodiversity over the next decade, new international frameworks being developed for the post-2020 period should include targets that acknowledge the way in which biodiversity is governed in cities and the contribution that cities make to conserve, restore and thrive with nature to guide urban action.

CONTENTS

1. INTRODUCTION

Local and subnational governments are increasingly being recognised for their critical roles in the implementation of the post-2020 Global Biodiversity Framework. To develop an understanding of how cities are (and can be) working with nature for protecting and reinforcing biodiversity, the NATURVATION project has analysed planned and implemented nature-based solutions (NBS) across European cities to examine and explore their current contribution and future potential.

According to the NATURVATION[2] project, NBS are deliberate interventions that can be inspired by or support nature in addressing urban challenges (Bulkeley et al., 2017). They are seen to hold significant promise in enabling the urban transition to sustainability and meeting several sustainable development goals, such as climate change mitigation, water management, land-use and urban development, social interaction promotion, and biodiversity conservation. This report presents the first in-depth analysis of how NBS across European cities are specifically addressing goals for biodiversity, which aim to support an urban component for the post-2020 biodiversity strategy.

This work was based on a sample of projects recorded in the Urban Nature Atlas, developed by the NATURVATION project. This sample of NBS projects involved different urban settings (namely urban parks, rivers, and community gardens). Through a systematic analysis of the biodiversity goals and explicit biodiversity actions of NBS in *conserving* nature, *restoring* nature, and *thriving* with nature (where this is understood to be seeking to purposefully realise what the IPBES Global Assessment refer to as Nature's Contributions to People and encompasses the benefits and values nature generates for individuals and society), we investigate the incorporation of biodiversity concerns in current urban NBS projects in European cities and explore how NBS are (and can be) contributing to urban biodiversity governance. In doing so, we seek to offer a new perspective on the cities' role in realizing global biodiversity.

The remainder of the report is organised into four sections. The following section two provides an overview of the methodology of this study, including a brief introduction of the Urban Nature Atlas, the case selection process, as well as the analytic framework adopted to examine how NBS contribute to biodiversity goals. Section three presents the key findings of the analysis, including an assessment of the type of biodiversity goals adopted within NBS projects, the detailed actions undertaken to achieve their biodiversity goals, and the diverse benefits generated that contribute to a thriving environment,

[2] http://naturvation.eu/atlas

economy and community. Section four reflects on these findings to draw out the key lessons about the ways in which cities in Europe are working with nature for biodiversity, and the challenges and potentials for supporting and improving the roles of city in the post-2020 biodiversity agenda.

2. METHODOLOGY

The analysis work that underpins this report was based on 199 NBS projects identified from the Urban Nature Atlas[3] (also referred to as the database hereafter), which was established by the NATURVATION project between January and September 2017. The database provided the first systematic survey of up to 1000 NBS interventions from 100 European cities, including 94 cities selected to be representative of European urban conditions from the Urban Audit and NATURVATION's 6 partner cities (Barcelona, Győr, Leipzig, Newcastle, Malmö, and Utrecht). The database involved surveying up to 10 NBS interventions in each of these 100 cities.

This analysis is based on the first results of the data analysis of in total 976 NBS projects (an updated database now includes 1000 cases), which was based on secondary sources (e.g. project reports and other project documents, websites, news articles, research articles, studies and blog posts). Data was interrogated using discourse analysis, and all answers reported in the Atlas are based, without exception, on factual information with a reference. Each NBS project included in the Atlas records information on its project goals and objectives, key characteristics based on its urban settings, ecosystem services provided, governance arrangements (including leading actors), and their direct beneficiaries and impacts, among others. The Atlas thus provides a basis to identify NBS projects that have biodiversity goals and explicit biodiversity actions, which enable the further in-depth analysis of the biodiversity contribution of urban NBS in European cities as presented below.

2.1 CASE SELECTION

To select a sample of NBS projects in which there were explicit intentions and measures to contribute to biodiversity – whether that be to *conserve*, *restore* or *thrive* with nature - and which represented the varied urban settings and the diverse leading actor groups (e.g. government or non-government actors) of NBS across European cities, a systematic approach was applied.

[3] https://naturvation.eu/atlas . The methodology and main findings of the first analysis of Urban Nature Atlas can be found in Almassy et al. (2018), available at: https://naturvation.eu/sites/default/files/result/files/urban_nature_atlas_a_database_of_nature-based_solutions_across_100_european_cities.pdf (latest access on 9th October 2019).

[4] http://ec.europa.eu/eurostat/web/cities/data/database

First, to identify NBS projects that are explicitly intended to deliver biodiversity goals and actions, we conducted a content analysis of the 976 NBS projects included in the Atlas. We selected NBS that related to specific biodiversity goals or targets and had one of the following words ("biodiversity", "species", "habitats" or "biological diversity") – in their "goals of the Intervention" or "implementation activities"; resulting in 351 projects. Subsequently, a further analysis of the urban setting of these 351 NBS was conducted. Figure 1 below shows the frequencies of NBS projects in different urban settings.[5]

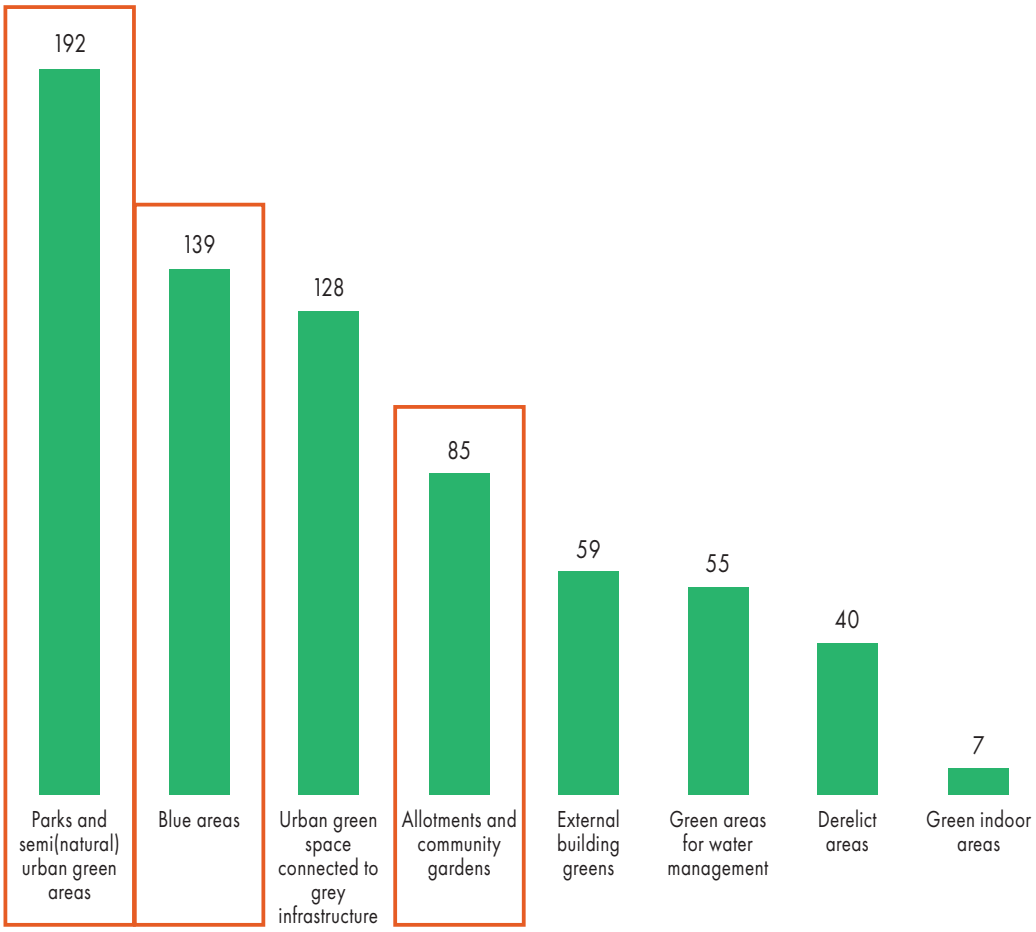

Figure 1. Urban setting of the 351 NBS with explicit goals and actions for biodiversity

Second, we selected three types of NBS (in total 199 projects) for further analysis from these groups of NBS projects. These include 107 NBS projects involving large urban parks and forests in the urban setting "parks and (semi)natural urban green areas", 64 NBS involving rivers/streams/estuaries in the "blue area" setting, and 65 projects involving community gardens in the "allotments and community gardens" setting (detailed figures can be found in Figure 2). As two projects related to community gardens were found to have no explicit biodiversity contributions in the following detailed discourse analysis (explained fully below), they were excluded from the study and leaving 63 projects involving community gardens. It is to be noted that a NBS project could be associated with more than one urban settings (for instance, there were 20 NBS projects involving both large urban parks and rivers, streams, and estuaries, 11 projects involving both large urban parks and community gardens, 6 projects involving both urban rivers and community gardens, and 2 projects related to all three urban settings). Therefore, there were in total 199 NBS projects analysed in this study. These projects spread across 82 European cities (see Figure 3). In terms of their stage of the intervention (as of June-August 2017), 12 were in planning stage, 1 was piloting, 93 were ongoing, and 93 were completed.

[5] When reviewing the results, it is to be noted that one project could include more than one urban location.

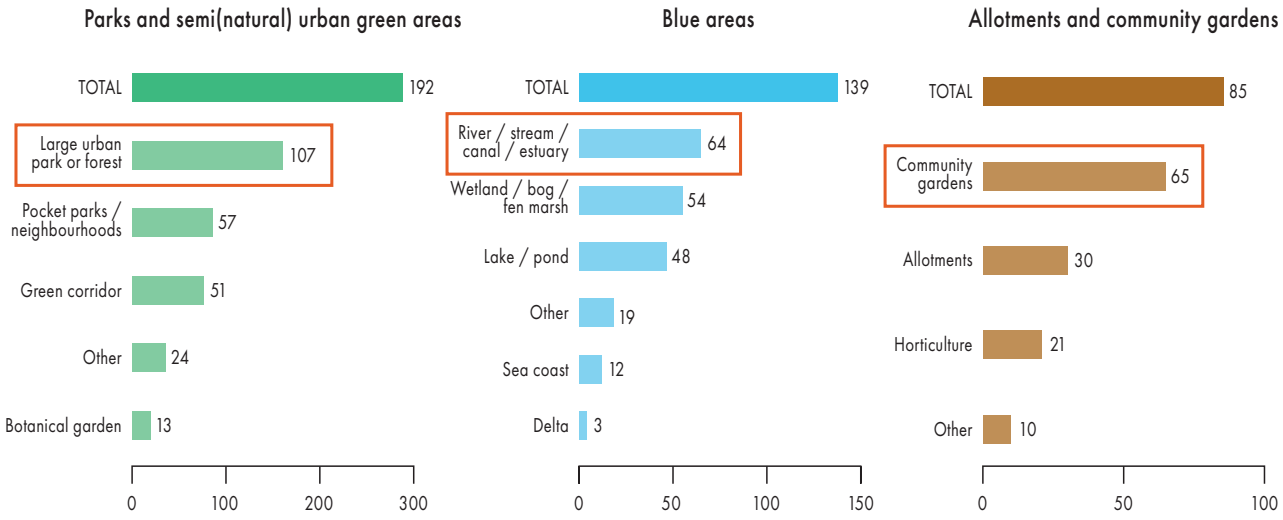

Figure 2. Frequency of NBS projects in three selected urban settings

Figure 3. Cities where investigated nature-based solutions are located. Naturvation partner cities are highlighted yellow.

The reasons for selecting cases from three different urban settings is twofold. First, we sought to include NBS located in different urban settings, involving urban green areas, blue areas and community gardens, in order to capture diverse ecosystems and urban sustainability challenges that might be at stake. Second, we sought to include cases that would represent a variety of key actors: the majority of NBS involving large urban parks (about 82%) and forests and river/stream/estuaries (about 95%) are government-led or involve some forms of hybrid governance, with merely 18% and 5% of projects respectively led by non-governmental actors; whilst for the 63 NBS in community gardens, there are 27 projects led by non-governmental actors, accounting for 42% of the total number. The diversity of urban NBS projects (in terms of their urban settings and leading actors) studied in this research allows us to develop a relatively comprehensive understanding of how a range of actors in different urban settings are seeking to govern biodiversity through NBS in cities across Europe.

2.2 ANALYTIC FRAMEWORK

For the 199 cases selected, we conducted an in-depth analysis in terms of their declared biodiversity goals and explicit implementation actions. For each case, we sought to identify whether goals and actions were intended to conserve, restore or thrive with nature through undertaking a discourse analysis of the project profiling recorded in the Atlas.

The novel approach adopted in this analysis to explore cities' contribution to biodiversity through NBS is to emphasise the ways in which cities can *conserve* nature, *restore* nature and *thrive* through working with nature. Conservation and restoration are fundamental elements to the Convention on Biological Diversity and are frequently addressed in existing biodiversity research. As defined by International Union for Conservation of Nature and Natural Resources (IUCN), conservation refers to "the protection, care, management and maintenance of ecosystems, habitats, wildlife species and populations, within or outside of their natural environments, in order to safeguard the natural conditions for their long-term permanence." The main goal of conservation is thus to prevent further degradation of natural ecosystems and resources (Young, 2000), although in practice the measures undertaken to achieve such a goal vary and can include the preservation, maintenance, sustainable use and enhancement of the components of biological diversity. While conservation mainly focuses on preventing ongoing degradation, restoration seeks to actively reverse such degradation (Garson, 2016). As defined by the Society for Ecological Restoration (SER), ecological restoration is "the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed." With cities' roles in biodiversity conservation being increasingly recognised, more attention is also being directed towards the restoration of urban green spaces for biodiversity habitat (Butt et al., 2018). Restoration activities have often focused on habitat improvement and planting; creating artificial structures for nesting, shelter or to facilitate faunal movement and connectivity between sites; control of pest or invasive species; and community engagement and education programs including citizen science and site or species monitoring programs (Threlfall et al., 2019).

More recently, as the Zero Draft of the Post-2020 Global Biodiversity Framework published in January 2020 makes clear, in addition to seeking to conserve and restore nature a central goal for biodiversity governance in the coming decade is to ensure that nature's contribution to people is also preserved and enhanced (CBD, 2020). Biodiversity is known to provide a series of benefits to people, including biological resource, ecosystem services, and social and spiritual benefits (Kearns, 2010). Yet the global loss of nature is threatening to reduce the potential for nature to contribute towards society in these ways. Therefore, it is of vital significance for biodiversity governance to identify a holistic development and conservation mechanism through which the needs of both human and (non-human) nature can be reconciled. In other words, there is a growing imperative to enable nature and society to thrive together. Our analytical framework therefore sought to build on the traditional focus of biodiversity governance – conservation and restoration – whilst also taking into account this new imperative, which in this study we call 'thriving with nature'. By deliberately casting the potential role of urban NBS in these terms, we sought to ensure that the diverse ways in which urban action might contribute to global biodiversity goals could be captured.

Having determined the basis for our analytical approach, we collected data entered under "goals of the intervention" and "implementation activities" of the NBS documented in the Urban Nature Atlas for analysis. In cases where this data was insufficient, other data recorded in the Urban Nature Atlas database, such as the "quantitative targets" and "indicators and specification of impacts", were further examined to acquire sufficient information for the analysis. This process also allowed the validation of the case selection results as two of the 65 NBS projects involving community gardens were found with no explicit claimed biodiversity goals and were thus not processed for further analysis. In terms of conservation and restoration, each NBS was analysed for the type of its biodiversity goals (i.e. genetic-based, species-based, and/or ecosystem-based) and the specific actions undertaken to achieve such goals. In doing so, our analysis draws on the three interconnected levels of biodiversity accepted by international conservation policy since the Rio Conference in 1992, namely the diversity of ecosystems; that of the species or the living organisms making up the ecosystem; and the genetic diversity within each species (UNEP, 1992). In terms of "thriving", we draw on the IPBES Global Assessment report together with the literature on the diverse and multi-functional benefits of NBS (e.g. da Rocha et al. 2017; Díaz et al., 2015; Kabisch et al., 2016; Terton, 2017) to identify nature's contribution to people along five dimensions: 1) cultural benefits; 2) social benefits; 3) economic benefits; 4) benefits for addressing climate challenges; and 5) benefits for environmental quality. This categorisation was done iteratively, such that as data was accumulated, new actions that had not previously been captured were added and analysis re-done for other cases in the sample. Table 1 provides a breakdown of the typology used to analyse the cases.

Table 1. Goals and implementation actions of NBS for conserving, restoring and thriving with nature

CATEGORY	TYPES OF GOALS	ACTIONS / CONTRIBUTIONS
Conservation	Genetic-based; Species-based; Ecosystem-based	Preserve and strengthen the existing habitats and ecosystems in the city and its hinterland
		Promote environmentally sound development in areas adjacent to protected/valued areas
		Create new habitats
		Preserve and strengthen habitat connectivity
		Reduce negative impacts and avoid the alteration and damage of ecosystem (e.g. the usage of pesticides, the release of genetically modified organisms, and harmful infrastructure expansion)
		Undertake specific measures to protect species (unspecified)
		Undertake specific measures to protect native species
		Undertake specific measures to protect endangered species
		Undertake specific measures to protect valued species
		Control and clean invasive alien species
		Take measures for ex situ conservation (e.g. establishment and maintenance of gene and seed bank, zoos, museums, breeding centre, and botanical garden/arboretums)
		Biodiversity offsets
		Manage and protect biological resources for conservation and sustainable use
		Raise public awareness
		Public engagement
		Create and use scientific knowledge for conservation
		Capacity building
		Protect and apply traditional knowledge and conservation practices
Restoration	Genetic-based; Species-based; Ecosystem-based	Rehabilitate and restore damaged or destroyed ecosystems
		Restore species (unspecified)
		Restore native species
		Restore endangered species
		Restore valued species
		Clear and control invasive alien species
		Restore ecological connectivity
		Public engagement

CATEGORY	TYPES OF GOALS	ACTIONS / CONTRIBUTIONS
Thriving	Social contribution	Education and scientific research
		Social cohesion and integration
		Safety (including reducing risk of crime and creating a physically safe urban environment)
		Liveability
	Cultural contribution	Recreation, exercise, sports and events
		Cultural heritage
		Aesthetic
		Artistic value
		Spiritual or religious value
		Sense of ownership and identity
		Connecting to nature
	Economic contribution	Carbon sequestration and emission reduction
		Flood prevention and regulation
		Drought (desertification) prevention
		Heat island effects reduction
		Micro-climate improvement
	Climate contribution	Carbon sequestration and emission reduction
		Flood prevention and regulation
		Drought (desertification) prevention
		Heat island effects reduction
		Micro-climate improvement
	Contribution to the environmental quality	Water regulation and quality
		Noise control
		Air quality control and improvement
		Pollution abatement
		Soil protection and amelioration

3. RESULTS

This section presents the key findings of the analysis. When reviewing the results, it is to be noted that whilst 166 out of 199 NBS projects took place in one type of location: i.e. they solely targeted one of the domains, there were 33 projects that involved more than one type of intervention: 20 projects covered both large urban parks and rivers/streams/estuaries, 11 cases involved both parks and community gardens, 6 cases were taking place in both urban rivers and community gardens, and two projects targeted all three urban settings.

3.1 HOW URBAN NBS CONTRIBUTE TO BIODIVERSITY

In general terms our analysis reveals that those NBS with an explicit intention to address biodiversity are currently focused primarily on *conserving* and with nature. This is especially evident in NBS projects involving large urban parks and community gardens, whilst cases related to rivers/streams/estuaries show a relatively even distribution of NBS projects in all three categories (Figure 4).

Further examination also found that urban river restoration projects commonly involved the "re-naturalisation" of watercourses or river beds (e.g. the restoration project in River Alt and Croxteth Brook in Liverpool, UK, and the work on the urban stream Wuppert in Wuppertal, Germany) as well as the restoration of ecological connectivity (e.g. the LIFE P.A.R.C. project that creates nine fish passes in Genova, Italy, and the 'Greening the Historical Canal' project in Utrecht, The Netherlands). Through these interventions, many other sustainable challenges such as water quality and flood management are also addressed. These results echo the key messages of the IUCN's report – *River Restoration and Biodiversity: Nature-Based Solutions for Restoring the Rivers of the UK and Republic of Ireland* – that "river restoration is important for achieving biodiversity conservation and sustainable development", and that "working with nature allows us to achieve many otherwise conflicting objectives" (Addy et al., 2016).

When reviewing the results, it is to be noted that the majority of NBS projects have multiple goals for conservation, restoration and for thriving. Examples of NBS cases with multiple goals include:

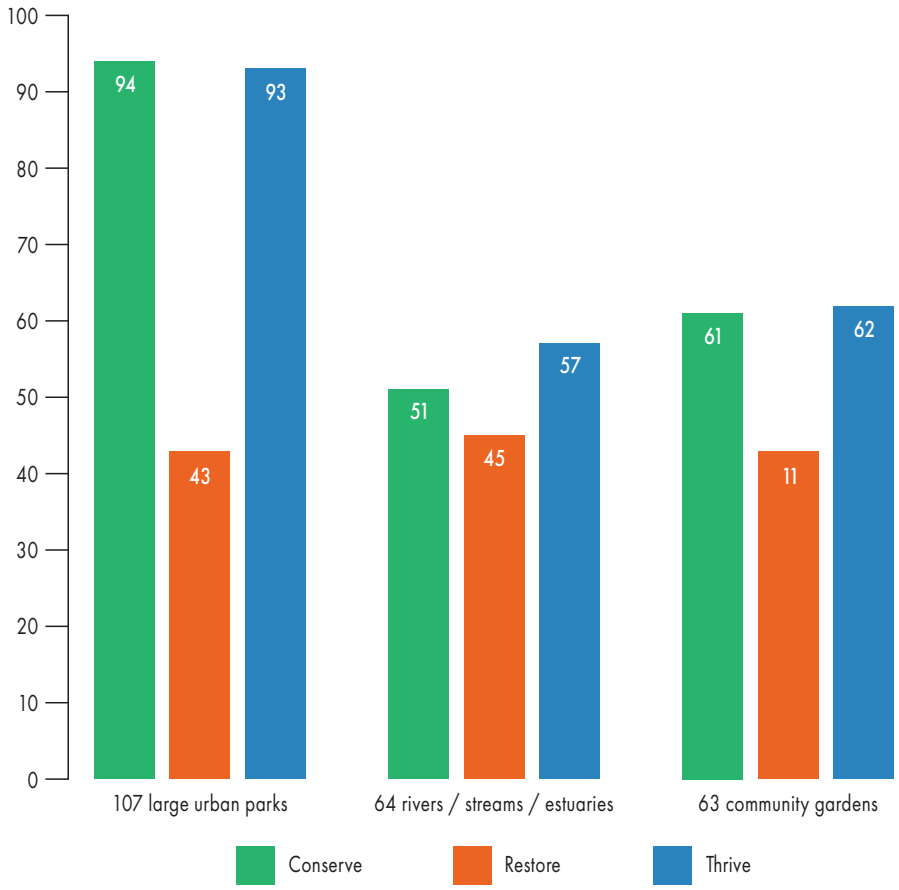

Figure 4. Biodiversity goals and actions of the three sets of NBS projects analysed in different urban settings and their frequency

- Urban river restoration projects often contribute to flood prevention, water regulation and quality, as well as the support recreational activities. One example found in the analysis is the **KingLambro: city regeneration project in Milan (Italy)**, which was initiated to strengthen ecological function by integrating it with urban functions. Main measures adopted in this NBS intervention included: restoring the naturalness of large sprawling areas; reinforcing the hedges and rows and channels system; and reorganising the public and agricultural functions in areas at risk of flooding.[6] Another example found is the **River Alt & Croxteth Brook Restoration Project in Liverpool (UK)**, which was initiated with the "thriving" goals to enable healthier, more productive and diverse ecosystems, improve water quality, reduce the risk of flooding, and form a new public green space for the community. Throughout the implementation process, culverts were removed to create "re-naturalised" water courses, which contributed to biodiversity protection.[7]

- Urban community garden projects that protect local biodiversity often also deliver multiple environmental, social and economic benefits. One example is the **Life Gardens in Zaragoza (Spain)**, which encouraged the natural farming of native species to regenerate the natural environmental system and protect local biodiversity. Besides its biodiversity contribution, environmental intervention in this NBS also aimed to halt the environmental degradation and remediate and improve soil fertility through the provision of training and technical assistance to entrepreneurs to support the development of local non-intensive farming business and through the support of individuals and markets.[8] Similarly, the **Urban**

[6] https://naturvation.eu/nbs/milano/kinglambro-city-regeneration-project.
[7] https://naturvation.eu/nbs/liverpool/river-alt-and-croxteth-brook-restoration-project.
[8] https://naturvation.eu/nbs/zaragoza/life-gardens.

Farming investment made by the property office of Gothenburg (Sweden) aimed to stimulate small-scale and residential/urban farming. While promoting biodiversity in the city, the goals of the project also included promoting the city's green development, spreading knowledge and creating contact between generations and people from different parts of the city and the world.[9]

- Park conservation along with landscape restoration and the benefit for thriving society. One example identified in this analysis is the **Villewälder (Villeforests) project in Bonn (Germany)**, whose goals included forestry protection, natural water balance restoration, and the enlargement of recreational area for citizens living in Cologne and Bonn.[10] Another example can be found in the "Lebende Rheinauen" **(Living Rhineauen) wetlands project in Karlsruhe (Germany)**, which aimed to achieve the enhancement of habitats and ecological connectivity, the recreation of natural floodplains, and the contribution to flood prevention and buffering.[11]

Examples of NBS with different types of goals are presented in Table 2.

CATEGORY	EXAMPLES
Conservation	*"The goal of the intervention is the conservation of protected species by means of creating habitat, creating breeding spots and promoting migration by creating an ecological infrastructure consisting of green spaces and green corridors."* (Ecological Infrastructure in Port of Antwerp, Belgium)[12]. *"The overall aim is to protect and preserve the upper part of the Ouseburn River, furthermore the project is aiming to improve the water quality and ecology of the river and will also be looking to survey and eradicate invasive species, remove litter, monitor wildlife and plant trees, which will keep the river cool, create riverbank habitats and help prevent bank erosion."* (Ouseburn River Restoration Project – Newcastle, the UK)[13]. *"The Conservatoire des Restanques presents numerous objectives, including the preservation of Mediterranean flora, the safeguarding and rediscovery of species or varieties of vegetables and fruit now forgotten in favour of homogeneous and more profitable commercial varieties."* (Preserving biodiversity in Conservatoire des Restanques – Marseille, France)[14].
Restoration	*"Wildlife Trust's vision is that this public forest estate is restored to its traditional mix of habitats, and that species like great crested newt, nightingale and small-leaved lime are able to thrive."* (Forest of Bere (Portsdown Hill) Green Infrastructure delivery – Portsmouth, UK)[15]. *"The aim is to restore the functionality of the local ecosystem by re-allowing regular flooding on the island from the Rhine and so restore the remarkable natural habitats present in the nature reserve."* (Restoration of Rhineland Alluvial Habitats – Strasbourg, France)[16]. *"The Living Environment Trust aims to promote environmental and sustainability awareness within local communities. The Trust uses the restoration of neglected inner-city green spaces as a way to engage a range of community groups, whilst also serving to enhance and expand the existing biodiversity and develop important community and education resources."* (The Living Environment Trust – Coventry, the UK)[17].
Thrive	*"The project aims to secure clean drinking water for the city's population; it also aims to create recreational areas for local residents and ensures biodiversity through provision of the optimum living conditions required for fauna and flora."* (Afforestation in the City of Århus, Denmark)[18]. *"The main goals are improving water quality, improving aesthetic and cultural/historical value and improving environmental quality within the canals of Utrecht, while at the same time, providing habitat and breeding ground for species and creating green corridors."* (Greening the Historical Canal – Utrecht, the Netherlands)[19]. *"Monlong Park was rehabilitated in 2012 with the explicit aim of strengthening social ties. The intervention ensured the park's provision of: a reception area of 550 m2, a central wooded area that enhances biodiversity and the environment for discovery and education, family and shared gardens, a natural water resources, and a greenway that connects the road from Lestang to the path of the fox and the road to Seysses."* (Monlong Park – Toulouse, France)[20].

[9] https://naturvation.eu/nbs/goteborg/urban-farming.
[10] https://naturvation.eu/nbs/bonn/villeforests-life-forests-waterworlds.
[11] https://naturvation.eu/nbs/karlsruhe/living-rhineauen-wetlands
[12] https://naturvation.eu/nbs/antwerpen/ecological-infrastructure-port-antwerp.
[13] https://naturvation.eu/nbs/newcastle/ouseburn-river-restoration-project.
[14] https://naturvation.eu/nbs/marseille/preserving-biodiversity-conservatoire-des-restanques.
[15] https://naturvation.eu/nbs/portsmouth/forest-bere-portsdown-hill-green-infrastructure-delivery.
[16] https://naturvation.eu/nbs/strasbourg/restoration-rhineland-alluvial-habitats.
[17] https://naturvation.eu/nbs/coventry/living-environment-trust
[18] https://naturvation.eu/nbs/arhus/afforestation-city-aarhus.
[19] https://naturvation.eu/nbs/utrecht/greening-historical-canal.
[20] https://naturvation.eu/nbs/toulouse/monlong-park.

3.2 TOWARDS URBAN CONSERVATION AND RESTORATION THROUGH NBS

Our analysis shows that current NBS projects that concern biodiversity placed emphasis on ecosystem biodiversity rather than species or genetic biodiversity goals: for instance, among the NBS projects involving large urban parks, 76 out of 94 ecosystem-based interventions have *conservation* goals and 41 out of 43 are *restoration* projects (see Figure 5 for detail results). It is to be noted though as the three levels of biodiversity are interconnected, actions at any given level could affect other levels.

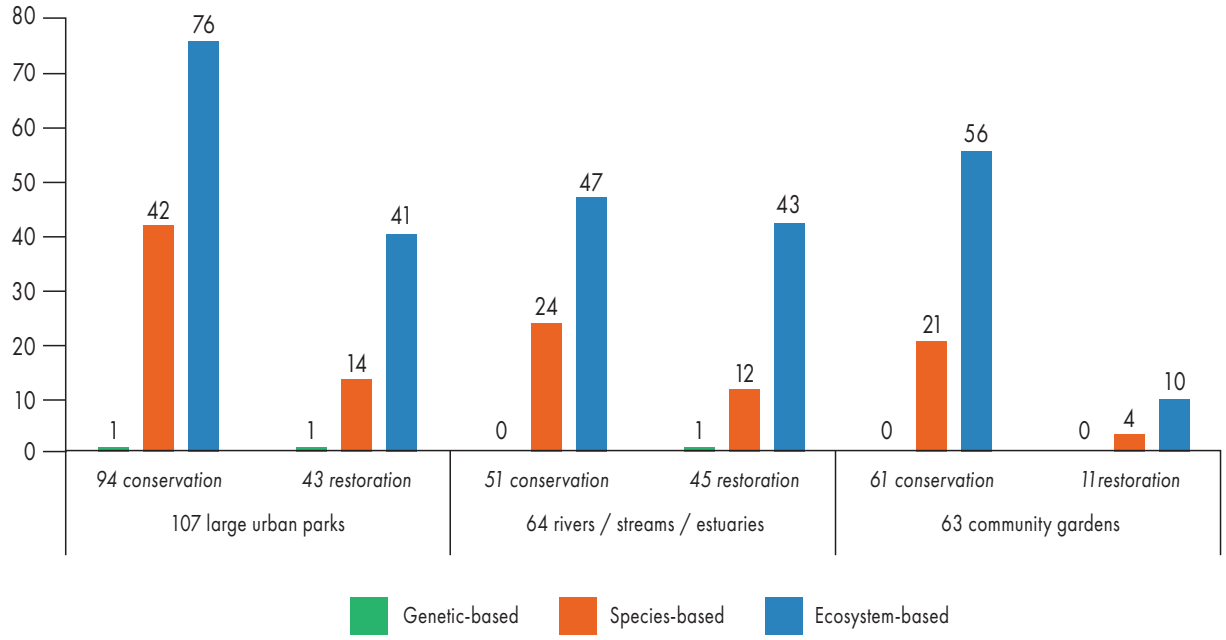

Figure 5. Types of conservation and restoration goals of the NBS projects and their frequency among the NBS projects

Ecosystem-based NBS often involve the conservation, restoration or enhancement of the integrity, functionality, and connectivity of habitats. For example, one goal of the project "Alna Environmental Park" in Oslo (Norway) was to secure biodiversity, habitats and good water quality in the region along the river; in the "Water Storing Green Park" project of The Hague (The Netherlands), the main goal was to improve ecological functioning of the area which improves biodiversity and water storage; and in the "Green and Blue Network project" in Montpellier (France), the goal was to ensure biological connections between the different natural spaces.

Meanwhile, a further review of these ecosystem based NBS projects found that besides the general descriptive goals for habitat protection and enhancement, a significant number of NBS have set quantitative targets for conservation and restoration efforts. For example, among the 93 ecosystem-based NBS projects that involved large urban parks (76 projects with conservation goals and 41 with restoration goals), 52 projects had explicit quantitative targets. Examples identified in the analysis of all three types of NBS projects include:

- **Number of trees to be planted**, e.g. "planting 18,000 trees and bushes" (the Krupp Park project in Essen, Germany) and "adding 135,000 plants" (Green Park on Highway Tunnel in Utrecht, The Netherlands).

- **Area of green or blue areas to be created or restored**, e.g. "afforesting 320 ha of new forest within four years" (the Afforestation in the City of Århus, Denmark) and "constructing a total of 23 ha of the park, 9,100 m^2 of water surface area, and 4.5 ha of a forest area" (the Krupp Park project in Essen, Germany).

- **Number of green spots created in the city**, such as "creating 10 diversified gardens in 33 different plots" (the community garden project in the City of Lille, France).

- **Number of species to be protected or reinforced**, e.g. "Protecting 80 species of nesting birds and 134 types of insects" (Teutoburg Forest Nature Park, Bielefeld, Germany) and "to preserve more than 12,000 endemic plant species" (The Diomidous Botanical Garden in Athens, Greece)

In comparison, there are fewer NBS projects that concerned species diversity, and these interventions display certain common features in their claimed goals and actions. First, many species-based projects (e.g. 16 out of 50 species-based NBS projects involved large urban parks, either with conservation or restoration goals) also employed quantitative targets in their goals of interventions. For example, the Asomadilla Park in Córdoba (Spain) was designed to stimulate a Mediterranean forest with 18 native species of Mediterranean flora, and the Ecological Infrastructure in Port of Antwerp (Belgium) launched a species protection programme for the conservation of 90 protected species by means of creating ecological infrastructures.

Second, whilst many NBS cases do not specify any particular species for conservation and restoration, a number of species-concerned NBS interventions did target one or several specific types of species. A typical example case is the Le Lez River programme launched by the City of Montpellier in France, of which one major aim was to protect the unique fish species that only exist in the river called "Chabot-du-Lez". Other examples include the conservation of the flowering plant Dictamnus albus (e.g. the Biodiversity Conservation project in Bologna, Italy); the protection and/or recovery of water voles (e.g. the River Restoration on the Guphill Brook in Coventry and the Water Vole Recovery Project in Reading, UK); the lizard (e.g. the city development project in the Central Railway Area of Munich, Germany); and the willow tit (Inspiring Water Action in Torne – Doncaster, UK). These species were either endangered or rare, and endemic in the region that were vital for the ecosystem.

It is also evident from Figure 5 that there were very few NBS projects involving specific genetic diversity goals and actions. Only three out of all NBS concerned were about genetic diversity. One project – the Mountain Forest Initiative in Augsburg, Germany – covered both urban parks and rivers, with the claimed goal to improve the age and species distribution of individual stocks. The other two were 1) the 'O'pflanzt' community garden in Munich, Germany, whose intervention goals include "promoting genetically diverse regionally grown seasonal crops"; and 2) the Glasgow Green Park in the UK that aimed to "introduce and preserve the already present species and maintain high genetic diversity".[21]

It is argued by Coates et al (2018) that current approaches to biodiversity conservation are paying little attention to genetic diversity and the species-population continuum. This is substantiated in this analysis of NBS across European cities. Genetic diversity was largely ignored, and while further case-based research is needed to understand the reasons for this, it may be that cities do not (yet) see themselves as key actors in relation to genetic diversity or already seek to address this in accordance with species richness through their actions at an ecosystem scale.

[21] Land & Environmental Services Glasgow Green Management Plan 2016-2019.
URL: https://www.glasgow.gov.uk/CHttpHandler.ashx?id=31510&p=0. Accessed on 27th June 2017.

3.3 NBS FOR CONSERVATION

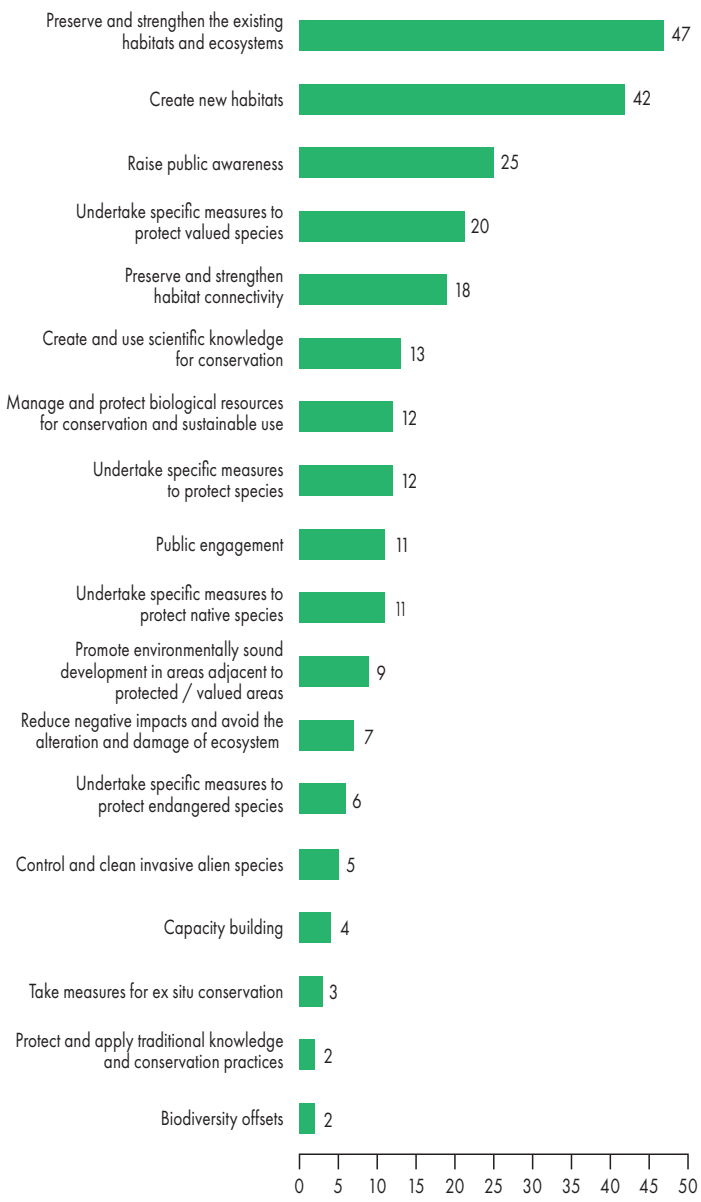

Figure 6. Frequency of conservation measures adopted by the studied nature-based solutions involving large urban parks

Figure 6, 7 and 8 provide an overview of the main conservation actions undertaken by NBS across European cities and their frequency. It is to be noted that one project could take more than one conservation measure. In keeping with the focus on ecosystem level conservation as a goal, our analysis of the main conservation actions undertaken by NBS found that in all three urban settings, two conservation measures that work at the ecosystem level were the most popular: 1) preserve and strengthen the existing habitats and ecosystems, and 2) create new habitats.

Meanwhile, the measure of enhancing and promoting public engagement was especially popular in NBS projects taking place in community gardens. Example cases included the Life Gardens project in Zaragoza (Spain), which provided training support and assistance to entrepreneurs who want to develop a business in local non-intensive farming; and the 'Beds and bees – Urban food for humans and bees' project in Karlsruhe (Germany), in which local residents participated in both the gardening and the bee-keeping initiatives. Public engagement in biodiversity conservation in NBS often involved a variety of urban actors, including volunteers (see projects: Rewetting Sandall Beat Wood in Doncaster, UK, and the Greening the Historical Canal project in Utrecht, The Netherlands), local community and users groups (e.g. Morningside Park in Edinburgh and the Balne Lane Fields project in Wakefield, UK), local schools (e.g. Sowe Valley project in Coventry, UK), local businesses (e.g. Urban eco-village New Bolton Woods project in Bradford, UK), landowners (e.g. Water Vole Recovery project in Reading, UK), and university students (e.g. Le Lez River project in Montpellier, France).

It is worth noting that although the importance of preserving and applying indigenous knowledge in biodiversity conservation has long been acknowledged (Gadgil et al., 1993; Harrison and Davis, 2002), it was undervalued in current urban NBS practices. Only seven projects (two in large urban parks and five in rivers) were found to involve the protection and application of traditional knowledge in their conservation practices. For example, the project 'Preserving Biodiversity in Conservatoire des Restanques' in Marseille (France) highlighted the knowledge of former Provençal farmers with the culture on the "bancaous" (restanques in Provençal)", which referred to two-facing retaining walls built in dry-stone landscape to create terraces for planting. Also, in the construction of community gardens of City Park in Barcelona (Spain), the lead actor – the Association of Friends of the Botanical Garden – focused on the cultivation of traditional horticultural breeds, so as to develop a vegetable garden of traditional varieties in the space of the Masía del Jardí Històric.

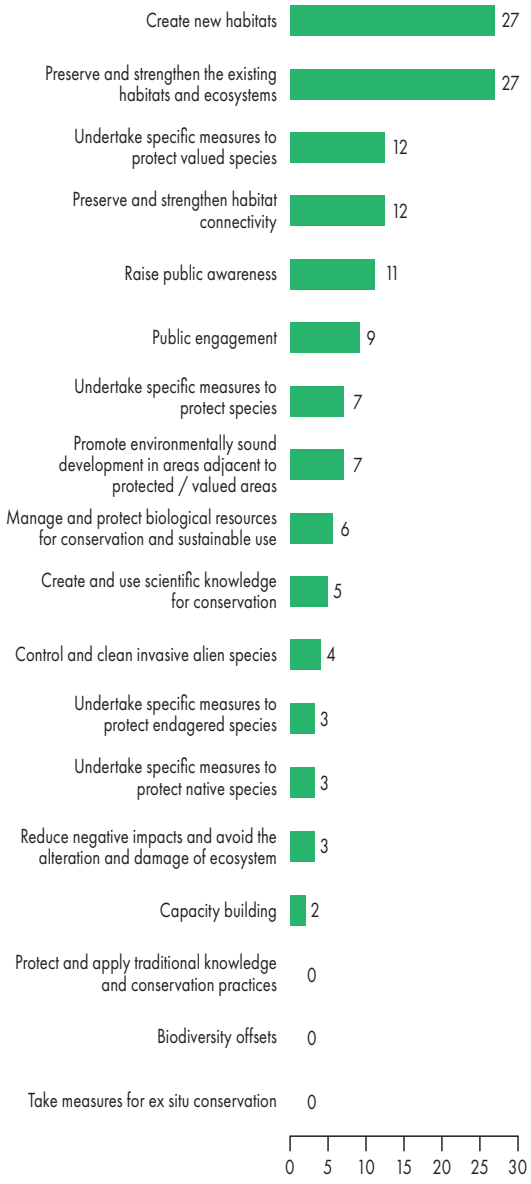

Figure 7. Frequency of conservation measures adopted by the studied nature-based solutions involving rivers/streams/estuaries

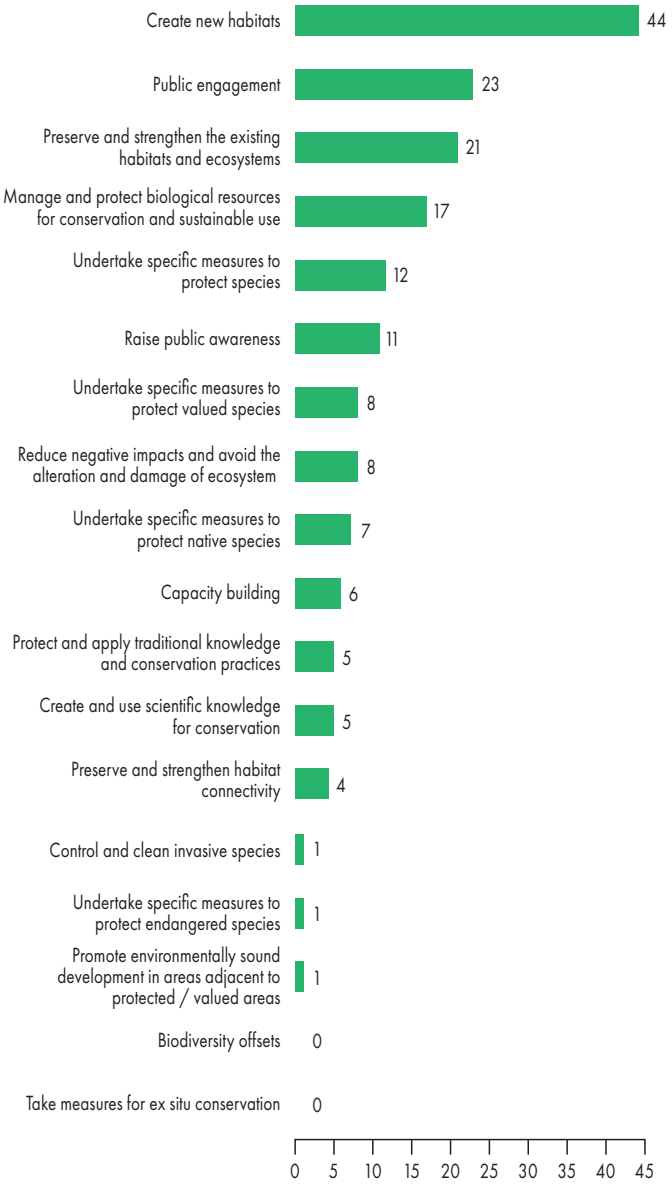

Figure 8. Frequency of conservation measures adopted by the studied nature based solutions involving large urban parks

Furthermore, the analysis found that although biodiversity offsetting schemes receive increasing endorsement across Europe and beyond (see, e.g. Defra and Natural England, 2013 and IUCN, 2016), they have low presence in current NBS projects.

Below, Box 1 provides concrete examples of NBS undertaking action of preserving and strengthening existing areas for habitat/ecosystem and creating new habitat/ecosystem, and Box 2 provides some concrete examples of how NBS use one or multiple measure(s) to achieve their conservation goals.

Box No. 1

CONSERVATION MEASURE 1: Preserving and strengthening existing areas for habitat/ecosystem

PROTECTING BIODIVERSITY AND ECOSYSTEM SERVICES OF FOREST （BIO.FOR.POLIS ） – NAPOLI, ITALY

BIO.FOR.POLIS is a project for the cities of Caserta and Napoli, aiming at improving the biodiversity of the two forests under study. As these two green spaces are located in urban areas, the challenge is to improve the conditions of the two ecosystems, despite the negative pressure of the urban environment. This is expected to produce environmental benefits and to mitigate the impact of human activity (Esperienze con il Sud, 2016). One main measure undertaken by the project to achieve the goals is to improve the condition of the different parts of the forest. Other measures include the construction of green streams to connect different sectors of the forests, the installation of artificial nests for birds, and the organization of guided tours into the forests.

See more details of this NBS project:
https://naturvation.eu/nbs/napoli/protecting-biodiversity-and-ecosystem-services-forests

CONSERVATION MEASURE 2: creating new habitat/ecosystem

ECO-DISTRICT PLATEAU DE HAYE – NANCY, FRANCE

The district of "Plateau de Haye" is part of the EcoQuartier approach, one of the most ambitious urban renewal projects. In line with the development of the New Urban Renewal Program, work was carried out on the challenges of opening up territory to its urban and forestry environment in order to confirm the "Forest City" approach initiated by the architect-town planner Alexandre Chemetoff. A forest, community gardens and a green corridor are being developed with a rainwater recovery system. Based on the natural heritage of the site, the emphasis is placed on the development of a forest park, the creation of a linear noise barrier and the construction of pedestrian paths, combining the paths of the Maxéville orchards and the hillsides. This vast park of 10 ha mixes forest, meadows, glades, walks and community gardens. A total of 18,500 trees are planted. This system is an original, lively and attractive equipment suitable for sports, leisure, and gardens. By maintaining the great natural equilibriums, the district offers an exceptional living environment to the inhabitants.

See more details of this NBS project: https://naturvation.eu/nbs/nancy/eco-district-plateau-de-haye.

Box No. 2

ECOLOGICAL INFRASTRUCTURE IN PORT OF ANTWERP, BELGIUM

The area of the Port of Antwerp is one of the most important habitats for threatened species, even at the European level. Therefore, a species protection programme was launched in 2014 for the conservation of 90 protected species. Main measures adopted in this project include creating an ecological infrastructure consisting of 'core areas' (large green spaces with a high ecological value), green corridors (long connecting zones, sometimes in the form of road verges) and 'stepping stones' (small green spaces that create connections between large green spaces and that provide suitable habitat and breeding possibilities. Additional measures included creating spawning grounds, ecological constructions in the water and quay walls that provide habitat, ecological riverbanks, temporary sand walls, creating pools and guide walls for toads and an ecological mowing programme for road verges and pipe/cable routes. As a result, the project was identified as species-based conservation intervention that adopted the following measures for achieving its conservation purpose:

- Create new habitat/ecosystem
- Preserve and strengthen the ecosystem connectivity
- Undertake specific measures protect endangered species

See more details of this NBS project:
https://naturvation.eu/nbs/antwerpen/ecological-infrastructure-port-antwerp

TEUTOBURG FOREST NATURE PARK – BIELEFELD, GERMANY

The Teutoburg Nature Park is the project that aims at increasing the recreation possibilities for local residents and creation of the local natural identity by protecting and developing the breeding of species in the protected areas; maintaining and increasing biodiversity; encouraging understanding for the importance of the nature conservation and protection. Besides producing several social-cultural and economic values (such as health, well-being, tourist, and recreation), the goals of this intervention also include the inclusion of selected territories of the Teutoburg forest to the pan-European "Natura 2000" network of protected natural sites for rare and threatened species, as well as rare biotopes and landscapes, and the reduction of negative impacts on nature. Detailed measures listed in this project include: 1. Creation of the Teutoburg breeding centre; 2. Collecting up-to-date information on threats and conservation needs for species and habitats exchanging experiences, case studies, and best practices; 3. Identifying common objectives, priorities and management actions; 4. Developing new management insights, (cross-border) stakeholders' cooperation frameworks, networks of specialists and site managers, etc.; 5. Prohibiting the: deliberate killing or capture of protected species by any method; deliberate destruction or taking of eggs or nests, or the picking, collecting, cutting, uprooting or destruction of protected plants; deterioration or destruction of breeding sites or resting places; deliberate disturbance particularly during breeding, rearing, hibernation, and migration; the keeping, sale, and transport of specimens taken from the wild; 6. Support of most Natura 2000 protected sites through establishing biological stations (10) transport of specimens taken from the wild; 6. Support of most Natura 2000 protected sites through establishing biological stations. Therefore, the project was considered as concerning both species diversity and ecosystem diversity, and employing the following measures for achieving its conservation goals:

- Preserve and strengthen existing (protected) area for ecosystem/habitat;
- Reduce negative impacts/avoiding alternation and damage of ecosystem;
- Undertake specific measures to protect endangered species;
- Undertake specific measures to protect valued species;
- Take measures for ex situ conservation;
- Creating and using scientific knowledge for conservation.

See more details of this NBS project:
https://naturvation.eu/nbs/bielefeld/teutoburg-forest-nature-park.

LE LEZ RIVER – MONTPELLIER, FRANCE

The Lez is a veritable ecological corridor within the Montpellier agglomeration, the most attractive area in Languedoc-Roussillon (a region in Southern France). Its strong economic and demographic development implies urban pressure on peripheral sectors, particularly north of Montpellier where many residential areas are developing. The river became protected thanks to the "Natura 2000 European network" which aims to reconcile human activities and the conservation of biodiversity on the basis of the main principles of sustainable development. Since 2011, Mayor of Montpellier, decided to launch the "Lez vert" program. Goals and actions of the intervention include: 1) the preservation, improvement and balanced management of water resources; 2) flood risk prevention and management; 3) prevention, restoration and management of aquatic environments and wetlands; 4) providing information and training in the field of water; 5) protecting the unique fish species that only exist in the river called "Chabot-du-Lez"; 6) walking path along the river for citizens to enjoy the fauna and flora. Therefore, the project also concerned about both species diversity and ecosystem diversity, and was considered to conserve biodiversity through measures as follow:

- Preserve and strengthen existing (protected) area for ecosystem/habitat;
- Undetake specific measures to protect valued species;
- Raise public awareness;
- Public engagement
- Creating and using scientific knowledge for conservation.

See more details of this NBS project:
https://naturvation.eu/nbs/montpellier/le-lez-river.

URBAN BUZZ CARDIFF: A BEE-FRIENDLY UNIVERSITY – CARDIFF, UK

"Urban Buzz" is a project run by the Buglife – The Invertebrate Conservation Trust (a British-based nature conservation charity) that uses innovative techniques to create 840 "Buzzing Hotspots" in England and Wales for declining pollinators. Cardiff City Council and Urban Buzz brought together local organisations, community groups supporting wildlife, to create environments to encourage more bees, butterflies, hoverflies and other insects. Pharma Bee, was a project implemented by the School of Pharmacy and Pharmaceutical Sciences of Cardiff University, with an aim to create a bee friendly campus. In association with Urban Buzz, it planned to renovate Cardiff University's Redwood Building by planting bee-friendly plants. Goals of this intervention include: 1) habitat creation for pollinators in urban area and increase pollinator habitats in urban environment; 2) improve habitat connectivity to make pollinators more resilient to changes such as development, climate change and pollution. To achieve these targets, the team installed beehives on the roof of the Redwood Building; trained members of staff as beekeepers; and planted the ground around the building with antibacterial and bee-friendly plants. Following this initial success, beehives have been installed on the roofs of a number of other campus buildings and the team has been working to create a beekeeper community. Therefore, this NBS intervention was identified as a species-based conservation project, and it employed the following measures for conservation:

- Create new habitats/ecosystem;
- Undertake specific measures to protect valued species;
- Public engagement;
- Capacity building.

See details of the NBS project:
https://naturvation.eu/nbs/cardiff/urban-buzz-cardiff-bee-friendly-university.

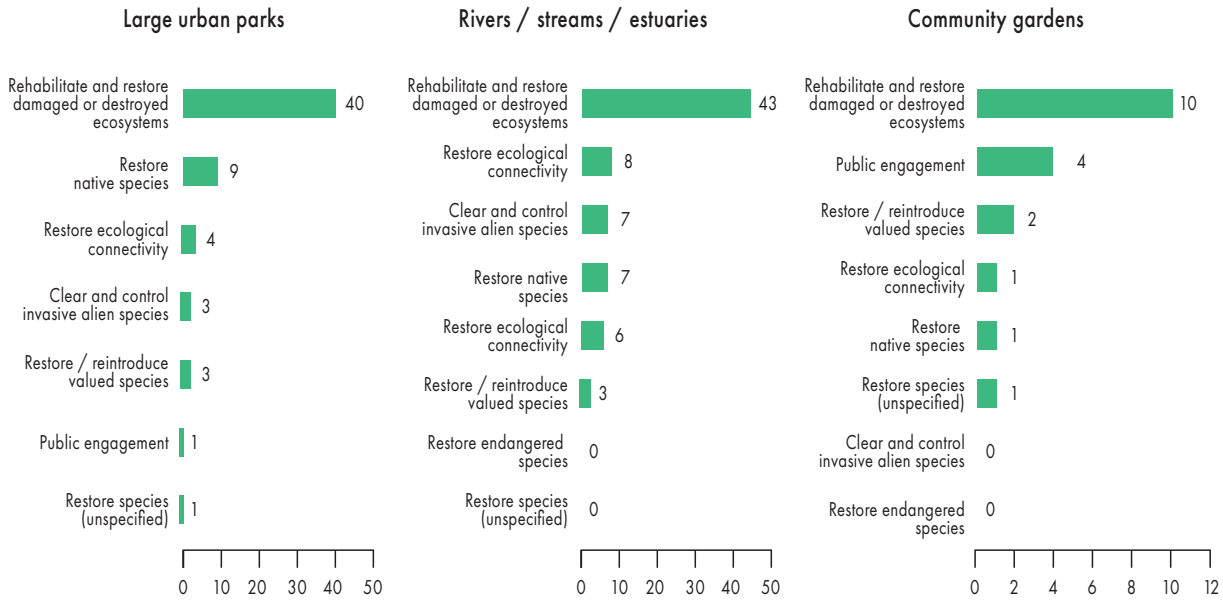

Figure 9. Frequency of restoration measures adopted by the studied nature-based solutions involving community gardens

3.4 NBS FOR RESTORATION

Figure 9 provides an overview of the main restoration actions undertaken by NBS in three urban settings across European cities and their frequency. Similar to the analysis of how conservation goals and actions are being pursued, one project could take more than one restoration measure. As can be seen, nearly all cases in three urban settings that involve restoration goals and efforts adopted the measure of rehabilitating and restoring degraded ecosystems. This includes 40 out of 43 NBS projects in large urban parks, 43 out of 45 in urban rivers, and 10 out of 11 in community gardens.

As expected, for NBS projects taking place in rivers, streams, and estuaries, the ecosystem rehabilitation and restoration was often about the re-naturalisation of water course or riverbeds. For example, in the Grémillon Stream Flooding Control Planning project in Nancy (France), the renaturation planned to slowdown the water flows and remove artificial banks to create a natural stream for ecological gain. Other examples include the Reconstructing the Hachinger Brook in Munich (Germany); the Revealing the Roch project in Greater Manchester (UK), and the restoration project in River Alt and Croxteth Brook in Liverpool (UK); and the work on the urban stream Wuppert in Wuppertal (Germany).

Box 3 below provides some concrete examples of how NBS undertook one or multiple action(s) to deliver their restoration goals.

Box No. 3

MEDWAY GREEN GRID - MEDWAY, UK

The park acted as a source of biodiversity for the whole Padana Plain. Many species were threatened by the loss or degradation of their habitats and the invasion of alien species. Of particular concern were the loss and degradation of wetlands and the degradation of streams, springs and secondary water courses. This project aimed at restoring the natural habitat and reintroducing the original plant and animal species, while keeping under control invasive alien species. Key implementation actions include: reintroduction of European sturgeon (Huso huso) in the River Ticino (and therefore in the Po basin); ecological restoration of springs and little streams for the conservation of fish species of Community interest typical of these habitats; restoration and creation of wetland habitats for breeding, migratory and wintering birds at Motta Visconti and Bernate Ticino; establishment of rafts with marsh vegetation for creating new sites for breeding, migrating and wintering birds. As can be seen, besides the conservation efforts to create new habitats, this NBS conducted restoration that concerned both species and ecosystem/habitat diversities through measures listed as follows:

- Rehabilitate and restore damaged or destroyed ecosystems
- Restore native species
- Clear and control invasive alien species

See details of the NBS project:
https://naturvation.eu/nbs/milano/ticino-park-enhancing-biodiversity-restoring-source-areas.

RIVER RESTORATION ON THE GUPHILL BROOK – COVENTRY, UK

Awickshire Wildlife Trust is currently undertaking an urban river restoration on the Guphill Brook, which could bring multiple benefits to diminishing wildlife and deprived local communities but also importantly to flood risk reduction, which is becoming ever more important with the increased negative effects of climate change. The project's aim was to restore the brook's natural features and enhance the surrounding habitat. Creation of pools connected to the river will give fish and invertebrates a place to rest and shelter but also importantly, have been designed to provide refuge and food for our most charming but sadly also most declined water dweller, the water vole. Objectives of this NBS intervention included: 1) to enhance the Guphill Brook and associated floodplain through restoring the natural geomorphological features; 2) to create online backwaters and associated wetland features; 3) to form a series of new wetlands to filter water flowing into and through the Guphill Brook, improving water quality; 4) to widen buffer strips, create wildflower habitat; 5) to increase shading of part of watercourse to reduce water temperatures; and 6) to provide habitat to facilitate a water vole recolonization or potential re-introduction. Implementation outputs of this NBS intervention included: re-profiled banks of brook to restore a more natural flow; increased area of fish spawning gravels and in stream vegetation; 2 back water areas totaling 100m^2; and enhanced 280m^2 buffer strip grassland. Meanwhile, it will also involve removing areas of Himalayan balsam and creating valuable wildflower rich meadows alongside the river. These will be sown and planted by local volunteers and will provide not only a source of food for water voles and invertebrates such as bees and butterflies but will act as a natural highway helping wildlife move between isolated habitats. Therefore, this NBS intervention concerned both species diversity and ecosystem diversity, and incorporated restoration actions as follows:

- Rehabilitate and restore habitats/ecosystems
- Reintroduce valued species – water voles
- Clear and control invasive alien species
- Restore ecological connectivity

See details of the NBS project:
https://naturvation.eu/nbs/bonn/community-gardens-elderly-people-dementia.

COMMUNITY GARDENS FOR ELDERLY PEOPLE WITH DEMENTIA – BONN, GERMANY

The project nature island Pennenfeld is a joint venture of the facility management and the association LeA which hosts a local residential community of elderly people with dementia. Its aim was the stepwise transformation of 1,800 sqm of lawn area adjacent to the living quarters into a wilderness/natural area for recreation and encounter in collaboration with its residents and neighbours. Besides enhancing quality of life for residents and elderly people living with dementia, the project's major objectives were enhancing biodiversity as well as strengthening cohabitation and mutual support in the neighbourhood. To achieve these goals, implementation of the nature area and the different garden elements was structured into 24 building blocks all of which were executed in communal work, supported by the neighbours, nature and youth associations and volunteers. Those elements consisted of elevated flower beds, natural hedges, a wetland, garden sculptures, a herbs garden and sowing wildflowers and other native plants. The use and reintroduction of indigenous plants was supposed to generate childhood memories for the elderly on the one hand and diversify the fauna by attracting animals of all kinds. Communal work and the joint implementation of garden elements by different stakeholders and resident groups, such as the wetland, was supposed to bring neighbours and elderly people closer together and lay the foundation for a feeling of community and belonging in the area. As can be seen, this NBS intervention concerned both species diversity and ecosystem diversity, and incorporated restoration actions as follows:

- Rehabilitate and restore habitats/ecosystems
- Reintroducing native species
- Public engagement in project implementation

See details of the NBS project:
https://naturvation.eu/nbs/bonn/community-gardens-elderly-people-dementia.

3.5 NBS FOR THRIVING

In terms of thriving, our analysis shows that NBS projects in different urban settings offer various benefits to people: in large urban parks, NBS that promoted cities to thrive with nature mainly bring cultural (70%) and social benefits (60%), as well as economic benefits (44%); in rivers/streams/estuaries, cultural benefits (65%) also ranked the top among the multiple contributions brought by NBS, which was followed by climate protection (53%) and environmental quality (51%); in community gardens, 84% projects brought social benefits and 52% provided economic benefits and cultural benefits (figure 10). Detailed measures undertaken by NBS to provide these contributions and their frequency among projects in different urban settings are presented as follows.

3.5.1 Cultural contributions

Analysis identified seven categories of cultural contributions provided by NBS in European cities, including: 1) the provision of opportunities for recreation, exercise, sports and various events; 2) safeguarding cultural and historical heritage; 3) aesthetic benefits; 4) artistic value; 5) spiritual or religious value; 6) sense of ownership and identity; and 7) connecting to nature. Figure 11 below provides an overview of the main cultural contributions provided by NBS in different urban settings across European cities and their frequency.

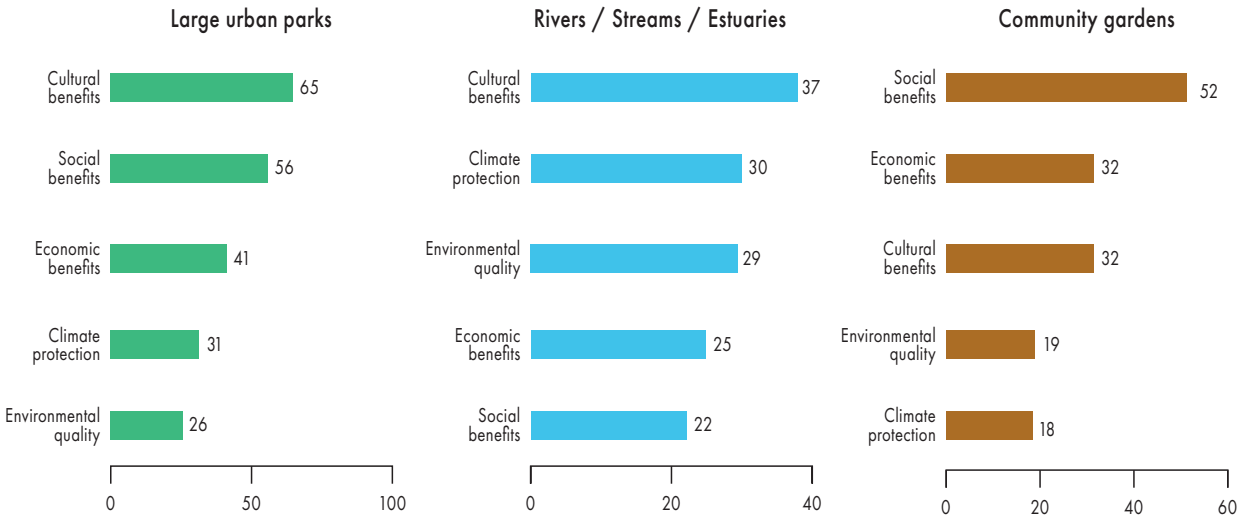

Figure 10. Multiple benefits provided by NBS in the three different urban settings and their frequency

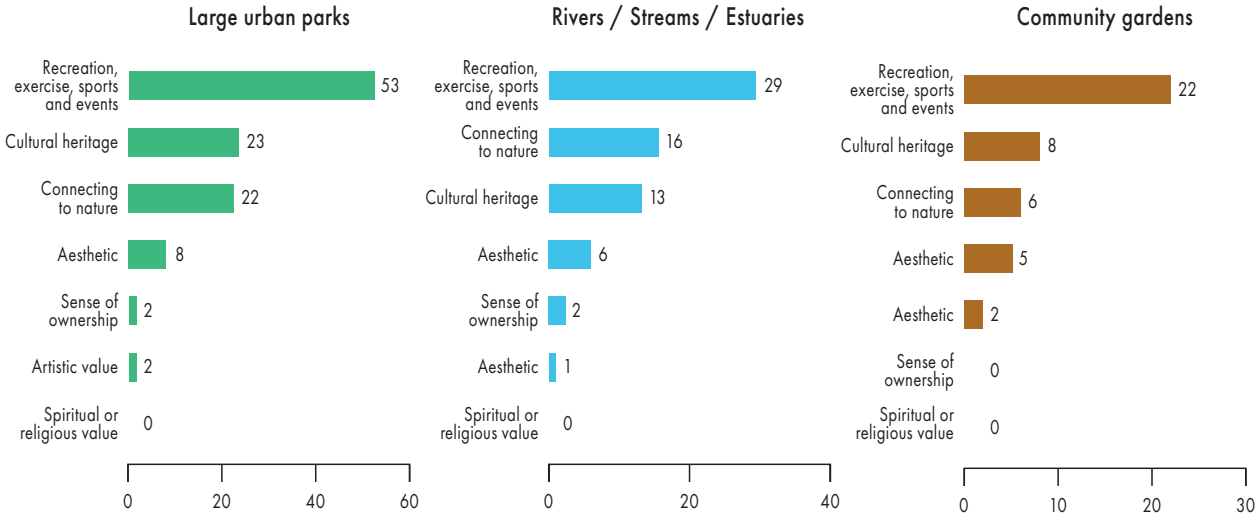

Figure 11. Diverse cultural benefits provided by the NBS in European cities

Previous research has shown that in regard to the associated cultural benefits of NBS, recreational benefits were most prevalent (da Rocha, Almassy, and Pinter, 2017). Similar results were obtained in this analysis as among the seven categories of cultural benefits we found that the provision and support of recreation, sports and exercise, and various events was the most mentioned: 53 NBS in urban parks (57%), 29 in urban rivers (51%), and 22 in community gardens (35%).

However, whilst aesthetic and spiritual benefits were found to be the second and the third most discussed cultural benefits of NBS in scientific literatures (da Rocha, Almassy, and Pinter, 2017), their existence in the goals and actions of NBS with specific biodiversity goals across European cities was not evident, especially there was no NBS found that was linked to spiritual and religious aspects. This could suggest that where biodiversity goals are at the forefront, there is a missed opportunity to also consider the wider cultural benefits of nature, in keeping with the history of urban conservation efforts being predominantly science-led.

In contrast, whilst literature reviews found that the cultural impacts of NBS related to safeguarding cultural and historical heritage were the least mentioned, this analysis showed that in practice, it has been recognised and embraced by many NBS projects across European cities: there were 23 NBS related to large urban parks concerned with cultural and historical

heritage, and 13 and 8 in NBS involving urban rivers and community gardens respectively. Actions undertaken by NBS to safeguard cultural and historical heritage mainly involve the following:

- Preservation and protection of cultural heritage sites. Examples include: The New Traditional Meadow Orchards in Wuppertal, Germany; the Morningside Park in Edinburgh, UK; and the Regeneration and Social Innovation in a Metropolitan Park in Bari, Italy.

- Restoration of environmental and cultural heritage. Examples include: The Green Ring in Antwerp, Belgium, and the Renovation of the Serralves Park in Porto, Portugal;

- Improvement of heritage sites for active use. Examples include: The Great Lines Heritage Park in Medway, UK, and the Alna Environment Park in Oslo, Norway.

3.5.2 Social contributions

Previous review of literature on the associated social benefits of NBS found that well-being enhancement (including people's mental health and physical health) and opportunities for social interaction (e.g. "improved sense of community", "meeting space for residents") were the most discussed in scientific literature (da Rocha, Almassy, and Pinter, 2017). The second most commonly identified social benefit was the provision of opportunities for various social interaction (ibid.). However, statistical assessment of the findings in this analysis showed a different result. As can be seen in figure 12, among various social benefits identified, education development and scientific research support were the most mentioned in NBS located in all three urban settings. This was often achieved through the provision educational sites situated in nature (e.g. the CITE educational and community garden in Liège, Belgium), the cooperation with education organisations (e.g. the Forest botanical garden "Marszewo" project in Gdynia, Poland), the establishment of an education institution (e.g. the permaculture farm in a community garden project in Wuppertal, Germany, and the Mill Leat Restoration in Bute Park, Cardiff, UK), and the establishment of educational programmes (e.g. community garden: old crop vegetable garden).

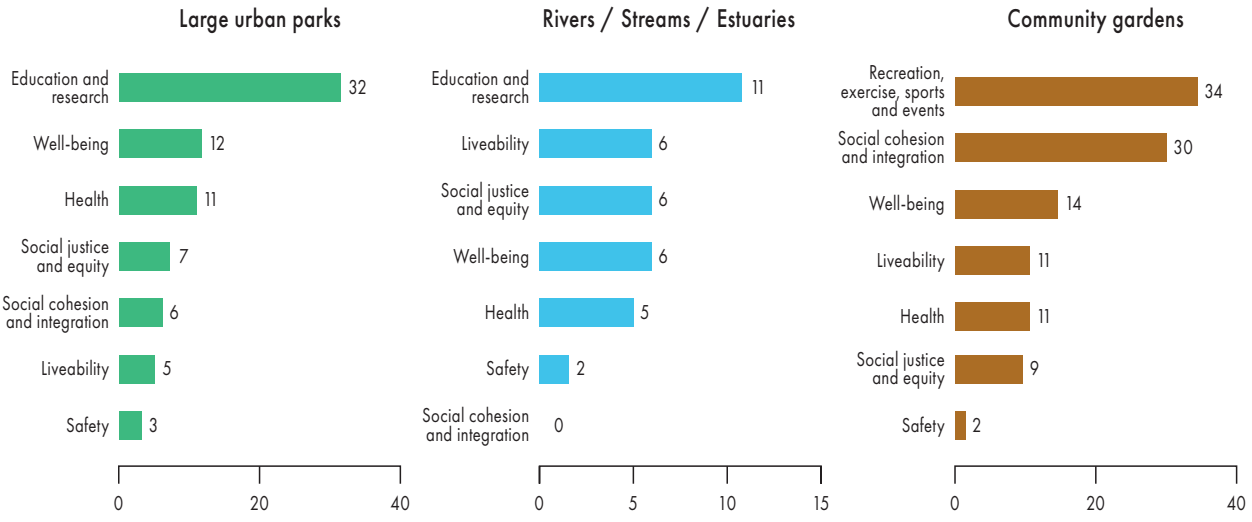

Figure 12. Different social benefits provided by NBS in European cities

Meanwhile, we also found some variation in the type of social benefits provided by NBS taking place in different urban settings. Whilst promoting social cohesion and integration was not mentioned in any NBS in urban rivers, it was incorporated in the goals and actions of only six NBS projects taking place in urban parks, and was the second most commonly identified

social benefit of NBS involving community gardens (30 out of the 62 NBS projects that involved contributing to thriving). Two example cases were:

- The Allotment Gardens in Oslo is a part of Norway's Allotment Association. Besides contributing to a better life quality and biodiversity, this project also emphasised the positive social, health, and welfare aspects of allotment life, especially the contribution to social cohesion in terms of the sense of belong in the allotment community.[22]

- An awarded sustainability experiment in the Eastern part of Karlsruhe in Germany named "Beds and bees: Urban food for humans and bees" combined plants and flower plots with beehives to create new space for humans and animals, and to increase the urban bee population. The community element of this project was fulfilled by local residents participating in the initiative that worked together with either gardening or bee-keeping, which creates a feeling of belonging in the district, based on the recognition that everybody's existence is interlinked, namely human-beings, plants and bees.[23]

3.5.3 Economic contributions

Urban nature-based solutions that have biodiversity goals are also seen to provide economic benefits in various ways (figure 13). For those projects that involved large urban parks and urban rivers, the associated economic benefits were mostly related to the promotion and enhancement of 1) urban regeneration and development; 2) local tourism; and 3) economic production such as agriculture.

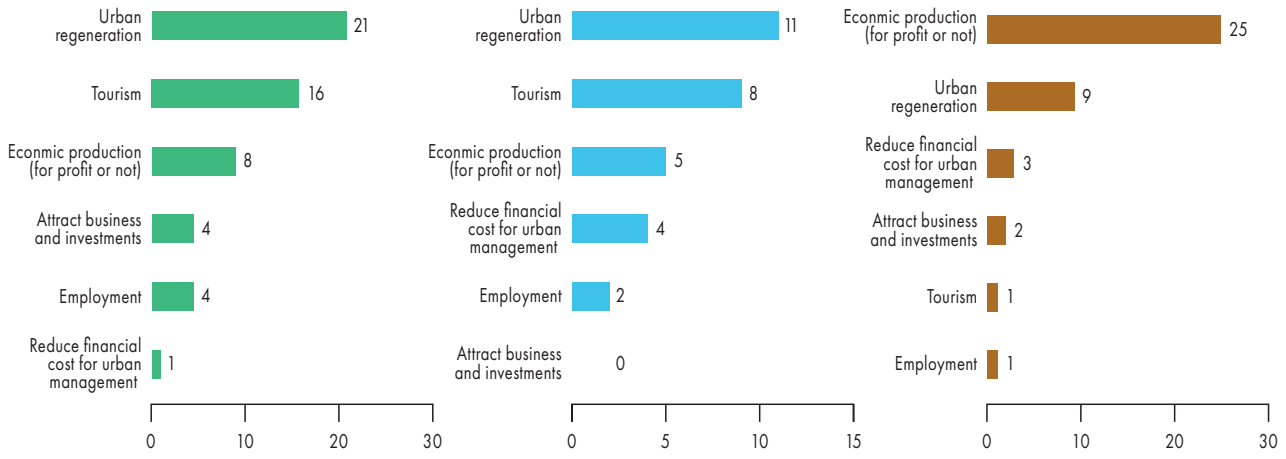

Figure 13. Different economic benefits provided by NBS in European cities

The contribution to urban regeneration and development was mainly achieved through three aspects: 1) the creation of new residences, office spaces, or commercial areas (e.g. the Bidston Moss Project on the Wirral, the Riemer Park project in Munich, and the pilot project Hilligenwöhren in Hannover-Bothfeld); 2) image improvement of the city or region (e.g. the Bidston Moss Project on the Wirral; the restoration of the Emscher River in Essen; and the recreation park Bremen West (Walle and Gröpelingen) in Bremen); and 3) the increase of property value in the area (e.g. two projects – the Nicolae Romanescu Park Rehabilitation and the Tineretului Park project – in Craiova, and the Creation of the Eastern Park in Porto).

[22] https://naturvation.eu/nbs/oslo/allotment-gardens-oslo.
[23] https://naturvation.eu/nbs/karlsruhe/beds-and-bees-urban-food-humans-and-bees.

For NBS involving community gardens, the main economic benefit delivered was through the promotion and reinforcement of economic production (either for profit or non-profit). Example cases include:

- In Glasgow, UK, a project has been implemented to turn a derelict area into a community garden. The goals of this intervention include habitat creation for certain species to increase biodiversity and to produce locally grown food. Today, the site is overlooked by 120 homes and is contributing to the urban green space as well as local food and market creation.[24]

- Since August 2004, the city of Montpellier has allowed residents to rent plots of garden, called "Les jardins Familiaux" (family gardens). The gardening practices contribute not only to the city's biodiversity preservation and urban landscape, but also to the own needs of citizens.[25]

- 'Blok 54' is a new building on the city island IJburg in Amsterdam, The Netherlands, on which a green roof and rain garden will be created allowing storm water to flow from the green roof through a groove with diverse vegetation, reflecting a natural creek. Besides its biodiversity and storm water retention values, this NBS also contributes to food production as fruit trees provide fruit such as apples and fruit bushes and plants provide strawberries and berries, which further allow for an annual harvest festival during which inhabitants can interact with each other (social cohesion).[26]

3.5.4 Contributions to climate protection

Currently, the concept of NBS is associated with the subject of climate change mitigation and adaptation, as well as biodiversity conservation (Potschin et al., 2014). Figure 14 presents an overview of the contribution provided by NBS across European cities in addressing climate challenges and their frequency in three different urban settings. As can be seen, NBS mainly contributed to climate mitigation and adaptation in five ways: 1) flood prevention and regulation; 2) heat island effect reduction; 3) carbon sequestration and emission reduction; 4) micro-climate improvement; and 5) drought and desertification prevention and mitigation.

For all three groups of projects analysed, flood prevention and management was the most discussed benefit for urban resilience and adaptation to climate change. Besides, NBS related to community gardens were also found to emphasise the benefits they can provide for mitigating and adapting to the urban heat island effect (e.g. the Ermekeil community gardening project in Southern Bonn, Germany27, and the Sea Heroes Community Garden in The Hague, The Netherlands[28]), which support the academic arguments of the climate benefits of urban gardens (Cabral et al., 2017; Tsilini et al., 2015).

However, it is noteworthy that although flood control was highlighted in current European NBS projects, the prevention of drought and desertification in urban areas was seldom stressed, with merely one of each NBS located in urban parks and rivers identified with related claims and actions. We thus suggest that future NBS projects should take the impact of drought and desertification prevention and amelioration into account on the same level as flood prevention and regulation, as climate change often causes increased floods in some areas and shortages and droughts in others.

[24] https://naturvation.eu/nbs/glasgow/derelict-area-turned-community-garden.
[25] https://naturvation.eu/nbs/montpellier/family-gardens-montpellier.
[26] https://naturvation.eu/nbs/amstedam/rain-garden-city-island.
[27] https://www.naturvation.eu/nbs/bonn/ermekeil-community-gardening-project-southern-bonn.
[28] https://naturvation.eu/nbs/hague/sea-heroes-community-garden

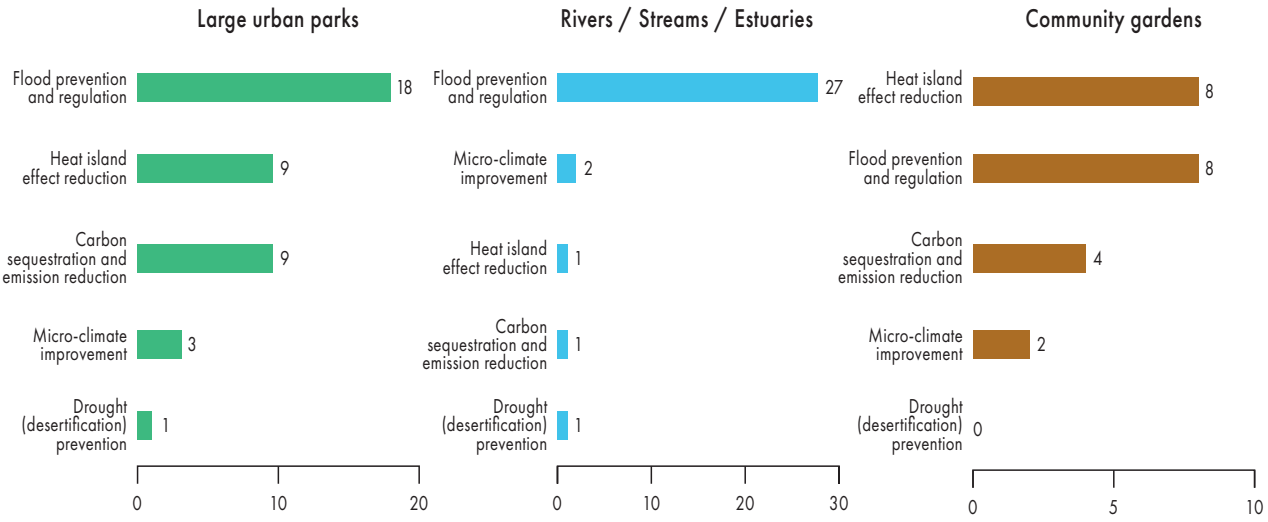

Figure 14. NBS' various contributions to climate challenges in European cities

3.5.5 Contributions to environmental quality

Analysis revealed that the main contributions of urban NBS for protecting and improving environmental quality are manifested in five dimensions: (1) water regulation and quality; (2) air quality control and improvement; (3) soil protection and amelioration; (4) noise control; and (5) pollution abatement.

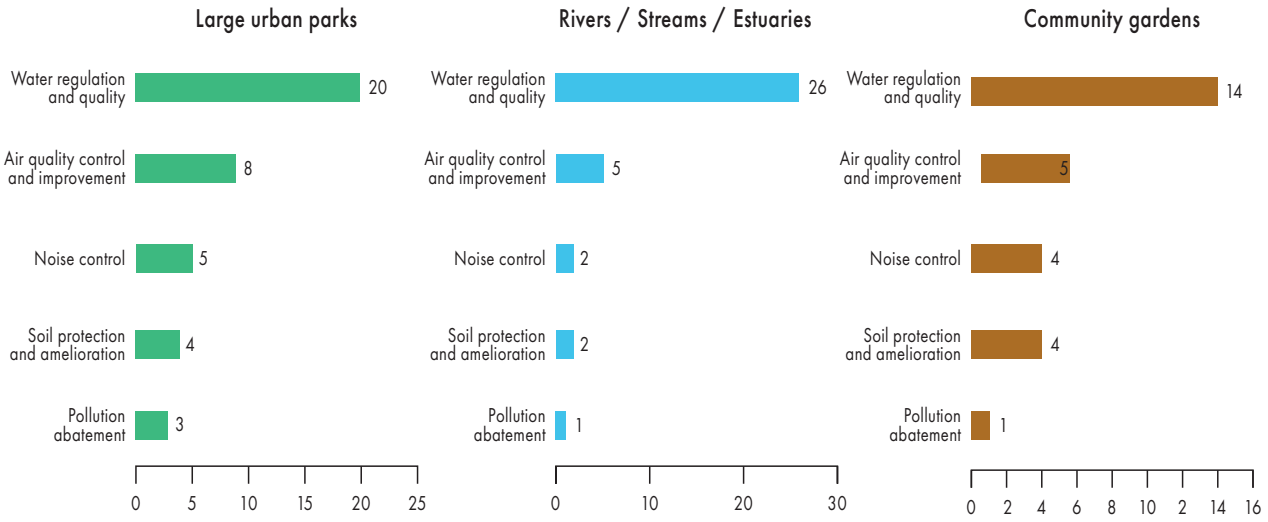

Figure 15. NBS' contributions for urban environmental quality in European cities

For all three groups of NBS projects analysed, water regulation and quality improvement was the most commonly identified benefit for urban environmental quality. This was followed by the air quality control and improvement. Whilst the findings showed that there were a few NBS projects contributing to soil protection and amelioration, it was relatively underrated. As the potential of NBS as a cost-effective long-term solution for land degradation (e.g. enhancing the soil health and soil functions) has been revealed (Keesstra et al., 2018), we suggest future NBS interventions consider its associated benefits for soil protection and enhancement.

3.5.6 Cases of NBS for thriving

Box 4 below provides concrete examples of NBS interventions through which cities thrive with nature.

Box No. 4

MEDWAY GREEN GRID - MEDWAY, UK

The Green Grid aims to link urban and rural neighbourhoods with a network of quality green spaces and corridors of landscape, with recreational and ecological value. The aim is to achieve the added benefits by managing open space resources as a set of linkable sites rather than in isolation. It is a planning intervention that is focussed on connecting a high quality, functional green space network. The intervention is part of "Greening the Gateway Kent & Medway". Goals specified in this intervention include: 1) create safer routes to work and schools; 2) provide access to nature; 3) support habitat for biodiversity; 4) provide outdoor classrooms and gyms, 5) provide a space for outdoor cultural events; 6) adapt to climate change (e.g. flood regulation); 7) attract investments; 8) attract visitors and tourists; and 9) a space for relaxation. Major implementation activities outlined in this project include: mapping the existing green spaces and their access points, including all types of ecological domains outlined in the action plan, among which are alleys and street hedges, railroad greens, playgrounds, institutional greenspace, riverbank greens, urban- and pockets parks, green corridors, allotments, community gardens and wetland; and creating green infrastructure to generate and connect seven "green routes" throughout the city.

As can be seen, besides its biodiversity conservation goals and actions, the project also contributes to the city's thriving with nature through the following dimensions:

- Social benefits
  - Education and research
  - Safety
- Cultural benefits
  - Recreation, sports, and events
  - Connecting to nature
- Economic benefits
  - Tourism
  - Attract business and investments
- Climate protection
  - Flood prevention and regulation

See more details of this NBS project at: https://naturvation.eu/nbs/medway/medway-green-grid.

ALNA ENVIRONMENTAL PARK - OSLO, NORWAY

Central aims of the project are to improve the self-cleaning ability of Alna, while maintaining biodiversity in the region and to inspire future urban development. Detailed implementation activities undertaken to address different SDGs were depicted in the project: SDG13(climate action) is addressed by the opening of several parts of the river as a means of flood prevention, as heavier and more frequent rainfalls are expected consequences of climate change. SDG6 (water management) is addressed by increasing water self-cleaning ability and facilitate purification of water seeping into the river from the surrounding road and industrial area by reconstruction of certain parts of the river. SDG15 (life on land) and SDG 3 (good health and well-being) as well as regeneration & urban development are addressed by the establishment of various recreational opportunities and parks along Alna, as well as the restoration of natural areas of high value, which act as important habitat. This allows for recreation and acts as an attractive gathering point for the citizens, as well as an inspiration for future urban development, where the many advantages and important functions of rivers are taken advantage of. Cultural heritage has been addressed by restoring and making places with cultural heritage value more available. Therefore, besides its contribution to the conservation and restoration of nature and biodiversity, the project was considered to also provide following benefits for the city to thrive with nature:

- Social benefits
  - Well-being
- Cultural benefits
  - Recreation, sports, and events
  - Cultural heritage
- Economic benefits
  - Urban regeneration and development
- Climate protection
  - Flood prevention and regulation
- Environmental quality
  - Water regulation and quality

See more details of this NBS project at:
https://naturvation.eu/nbs/oslo/alna-environmental-park.

OPEN GARDEN IN BRNO, CZECH REPUBLIC

Situated in park Spilberk, the garden features a building with a green roof and a garden with various plots. The building is designed to be carbon neutral and reuses rainwater for toilet flushing and for watering the garden plots. The garden is used for horticultural purposes and environmental education, as well as animal and bee keeping. The complex improves the local micro-climate through cooling and humidification and promotes biodiversity. Building a green roof on the house provides multiple benefits for ecosystem, economy and community. These include: 1) supporting biodiversity by providing a habitat for birds and insects; 2) providing environmental education, including sustainable horticulture education, bee keeping and animal care education, sustainable cooking and herbal cosmetics courses, picnics, private events; 3) providing a place for recreation; 4) Efficient handling of rainwater through a wetland biotope on the roof garden that cleans the grey water and a storage pond that used rainwater for irrigation and other purposes; 5) providing energy requirements for the building in a carbon-neutral way; 6) reducing air pollution and purifying the air; and 7) connecting different urban public spaces and moods, parks with streets, courtyards with gardens. Therefore, besides contributing to biodiversity conservation, the project was identified to provide following benefits for the city to thrive with nature:

- Social benefits
  - o Education and research
- Cultural benefits
  - Recreation, sports, and events
- Economic benefits
  - Urban regeneration and development
- Climate protection
  - Carbon sequestration and emission reduction
- Environmental quality
  - Water regulation and quality
  - Air quality control and improvement

See more details of this NBS project at:
https://naturvation.eu/nbs/brno/open-garden-brno.

4. DISCUSSION AND CONCLUSION

There is an increasing recognition of the potential and significance of NBS for biodiversity conservation and ecological restoration (Cohen-Shacham et al., 2019). However, the role of such approaches for addressing biodiversity protection through the urban realm has not been fully acknowledged in current biodiversity governance, where existing discourses and policy frameworks at the national and international levels tend to either ignore the role of cities in achieving biodiversity outcomes or consider urbanisation as a threat to such goals. While there is strong evidence to suggest that current levels and dynamics of urbanisation are adversely affecting biodiversity, neglecting the positive roles that cities can play towards biodiversity outcomes represents a missed opportunity for harnessing the governance capacities needed to address the problem and is likely to perpetuate rather than ameliorate the effects of urbanisation on biodiversity loss. In short, rather than only considering cities as a threat for biodiversity, in order to engage urban actors and communities in working towards improved biodiversity outcomes, it is critical to identify the ways in which urban action can contribute to these wider global goals.

In order to build the evidence base concerning how cities are currently making a positive contribution to biodiversity goals through NBS projects, and what this might mean for global biodiversity governance, this report provides an initial analysis of the ways in which European cities are addressing biodiversity concerns through the implementation of NBS. We developed a three-fold analytical framework to capture this contribution as involving efforts focused on conservation, restoration and thriving with nature. Taking our starting point as the 976 cases of NBS included within the Urban Nature Atlas, we found that only little over a third (351) are explicit in including biodiversity goals and actions in their design and implementation. Our first finding is therefore that there is a significant missed opportunity for addressing biodiversity at the urban level as cities increasingly engage with NBS. The NATURVATION project will over the next few months investigate pathways for mainstreaming NBS in urban sustainability approaches that can ensure biodiversity challenges are taken into account throughout the design and implementation of NBS interventions.

Through our analysis of 199 cases we found that for those NBS interventions that explicitly include biodiversity, their goals and actions varied. Here, the form that NBS take plays a significant role. NBS that work with nature in urban parks and community gardens focused primarily on conservation and thriving with nature (through mobilising nature's contribution to people), with much less attention given to goals for restoration. In contrast, where NBS involve urban rivers/streams/

estuaries, restoration had received a relatively similar level of emphasis as conservation and thriving. This suggests that as the international community come to focus on a 'decade of restoration' engaging urban actors in sharing their lessons from such projects and seeking to further embed restoration across different urban landscapes could also provide a means through which to further accelerate urban engagement with global biodiversity goals.

Across all types of interventions, we found that their biodiversity goals and explicit implementation actions were primarily ecosystem-based, focusing on the protection, restoration or enhancement of the integrity, functionality, and connectivity of habitats and ecosystems. In general, there were fewer species-based NBS projects amongst our sample, and very few projects concerned with conserving or restoring genetic diversity. Future urban NBS interventions may be able to enhance their contribution towards global biodiversity goals by including a greater focus on the species and genetic elements of biodiversity conservation and restoration, both in terms of project design and by monitoring the effects of those efforts focused at the ecosystem level in terms of their contributions to protecting key species or creating new opportunities for endangered or locally valued species to be reintegrated into local places. This is likely to require capacity-building at the local level in terms of both building the relevant expertise and in terms of developing appropriate assessment tools.

Further examination of the detailed goals and explicit actions of the projects included in this analysis found that a number of NBS interventions adopted quantitative targets to guide their implementation, such as number of trees to be planted, area of green or blue areas to be created or restored, number of green area to be (re)created, number of species to be protected or reintroduced, and number of jobs to be created. European cities are therefore taking quantified, measurable actions for biodiversity conservation, restoration and for thriving with nature. This may provide the foundation for engaging cities in moving towards global goals, by attending to the kinds of targets and indicators that are seen to be relevant, practical and measurable at the local level. Rather than operating through a system of internationally determined targets, as has been the case over the past decade with the focus being on the Aichi Biodiversity Targets, this may suggest that once the overall goals of the global framework for biodiversity governance have been established, a degree of flexibility in terms of how they are interpreted and implemented locally will be required in order to make them meaningful. Furthermore, given the increasing momentum behind initiative-led experimentation as a mode of governing sustainability in the city, it is likely that targets that only focus on plan development and implementation will not suffice to capture and further improve the kinds of actions through which cities (at least in the European context) are acting on biodiversity goals.

These findings rest on a particular investigation into the biodiversity contribution of current NBS projects implemented across Europe and are therefore subject to several limitations. First, our research is based on the analysis of secondary data and was focused on the declared intention and the implementation activities published or reported by the NBS examples studied in this research. As is the case with environmental discourse analysis more broadly, this does not tell us about the on-the-ground implementation of the projects or whether their intentions have been realised. Second, by focusing on the project-based initiatives without explicitly analysing their links to the wider institutional policies and goals we cannot establish whether these NBS initiatives have been undertaken in relation to urban biodiversity action plans. However, given that recent analyses suggest that fewer than 150 such plans have been produced globally and our analysis found no explicit mention of Local Biodiversity Strategy and Action Plans (LBSAP) or other elements of the biodiversity planning system (e.g. Aichi Targets) (The Nature Conservancy, 2018), we consider this to provide a novel form of urban biodiversity governance.

Even with these limitations in mind, this study of how cities are working towards biodiversity goals suggests that it is imperative that the contributions that cities can make to conserve, restore, and thrive with nature through NBS are recognised and valued by those seeking to make the case for strengthening the role of local and sub-national action within the post-2020 governance framework. First, recognising the ways in which biodiversity is practically being pursued through such forms of intervention at the local level will be critical if these efforts are to be scaled up and mobilised globally. The mobilisation of cities towards climate change goals globally has relied on the efforts of transnational municipal networks and multilevel governance frameworks that have been able to account for and support a wide range of initiatives and actions within and beyond local

climate change plans. Indeed, much of the experimentation taking place in cities towards climate change has been directly financed or rewarded through the global policy framework (e.g. the NAZCA platform). Given that it is in relation to climate change that urban action for sustainability has been most successfully mobilised to date, there are important lessons here for how a similar groundswell of action can be engendered in the biodiversity domain.

Second, without attending to the ways in which biodiversity governance is taking place through urban NBS projects, there is a risk that any new framework for post-2020 biodiversity governance will fail to provide the appropriate levels of ambition, governance arrangements, structures of finance and forms of recognition necessary to support its implementation on the ground. The Zero Draft of the post-2020 governance framework published in January 2020 takes an overly narrow view of the capacity of local governments, focused primarily on their planning powers and neglecting the other capacities that they can bring to the table. Without a full recognition of how cities can support the post-2020 biodiversity agenda, it is likely that we will continue to witness a missed opportunity for aligning biodiversity action with work that cities are already undertaking with nature reducing the possibility for meeting ambitious global targets and leading to the impoverishment of urban life.

Overall, we find that cities are contributing to biodiversity governance through the implementation of NBS, and doing so in ways that encompasses both biodiversity for its own sake as well as in terms of nature's contributions to people, and often adopt goals and targets that are quantifiable and measurable. In a context where such actions are rarely considered as making a meaningful contribution to biodiversity, either directly or because of their benefits in shaping the views and values of the majority of the world's population and economic actors who live and work in cities, there is an emerging need for transnational and international governance arrangements that can acknowledge the contributions of cities that are working for biodiversity and can guide other cities to take actions towards biodiversity in their jurisdictions. We hope that these findings provide insights that can ensure that the post-2020 biodiversity governance framework is able to provide the basis for furthering urban action towards biodiversity goals, and that such goals can support ambitions for urban sustainability globally. Appendix A provides an initial draft of a set of goals derived from our analysis that could support global frameworks for the inclusion of urban action in the post-2020 governance framework.

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APPENDIX A

Note that these targets are informed by the analysis conducted for this report together with the IPBES Global Assessment which identifies priority areas for action as well as the specific requirements for target setting and monitoring, advocating the importance of SMART targets. Such an approach may not be viable in all urban contexts, where data and capacity are often in short supply. Adopted versions of such targets to suit local circumstances are possible, for example rather than reporting on the change in area or activity a target for future ambition could be indicated. The intention is that this provides a range of different types of targets that contribute to the overall goals of conserve/protect, restore and thrive that form the basis of the current CBD and the New Agenda for Nature and People and hence provide a set of templates that cities could choose from/adapt to their context. A commitment platform could be designed such that cities select one or more type of target from these three 'baskets' and formulate them in a more/less quantitative manner. The 'back stage' of the commitment platform could then aggregate quantitative targets and record the extent to which cities were setting targets that contributed to Aichi Targets, SDGs and any other global goals that emerge in the post-2020 Biodiversity Framework. This broad but SMART approach has the advantage of then not needing the platform to be redesigned/city commitments reorganised if global goals are shifted. It may also be desirable to add a group of targets related to commitments and processes for planning/action, which have not featured in our analysis of NBS initiatives. In addition, these targets could be used to 'ratchet' additional commitments over time through processes of recognition/reward (e.g. bi-annual awards for transformative action for biodiversity).

Table 1: Conservation (11 goals)

Issue / Driver / Lever (science-based as derived from IPBES / Naturvation evidence base)	Potential target (designed to relate to urban experience and practice)	Formulation (SMART)	Tags (additional tick boxes required on web data entry form)	Associated Goals (additional tick boxes required on web data entry form)
Urban encroachment land conversion	Reduce the rate of land conversion within the city and urban periphery	Reduce the % of land within the city-region converted from natural habitat or agriculture to urban development by X from 2020 to 2030/2050 Ensure that the % of land within the city-region converted from natural habitat or agriculture to urban development is below X% over the period 2020 -2030	City is located in biodiversity hotspot (list provided to tick)	
Urban encroachment land conversion	Proportion of urban development near protected areas that includes conservation considerations	Increase the % of urban development located near protected areas that include measures to protect and enhance nature to X % by 2030	City is located in a biodiversity hotspot (list provided to tick) Natural habitats included in calculation (terrestrial, rivers, marine) (check boxes)	
Safeguarding remaining habitats/increasing protection for habitats	Proportion of urban land covered by protected status	Maintain the % of protected natural habitat and green space in the city between 2020 – 2030/50 Increase the % of protected natural habitat and green space in the city by X% between 2020 – 2030/50	City is located in a biodiversity hotspot (list provided to tick) Natural habitats included in calculation (terrestrial, rivers, marine) (check boxes)	
Safeguarding remaining habitats/increasing protection for habitats	Reduce the use of pesticides	Reduce the % of green space in the city treated with pesticides by X over the period 2020 – 2030 Phase out the use of pesticides in the management of urban green space by X date	City is located in a biodiversity hotspot (list provided to tick) Total Ha of urban green space in the city to which this target applies (check boxes of ranges of Ha)	
Safeguarding remaining habitats/increasing protection for habitats	Reduce invasive or alien species	Reduce the % of natural habitat affected by alien invasive species by X % over 2020 - 2030	City is located in a biodiversity hotspot (list provided to tick) Natural habitats included in calculation (terrestrial, rivers marine) (check boxes)	
Connecting existing habitats to reduce fragmentation and improve connectivity	Proportion of urban land converted to natural habita to increase connectivity	Provide X ha of additional areas of protected natural habitat and green space to improve connectivity between 2020 – 2030/50	City is located in a biodiversity hotspot (list provided to tick) Natural habitats included in calculation (terrestrial, rivers marine) (check boxes)	

Issue / Driver / Lever (science-based as derived from IPBES / Naturvation evidence base)	Potential target (designed to relate to urban experience and practice)	Formulation (SMART)	Tags (additional tick boxes required on web data entry form)	Associated Goals (additional tick boxes required on web data entry form)
Safeguarding species increasing protection for species	Increasing number of species over time	Increase the number of species X by % Y over the period 2020 -2030	City is located in a biodiversity hotspot (list provided to tick) Type of species (bird, mammal, fish etc tick boxes provided) Status of species (red list, rare, important local value etc. tick boxes)	
Urban consumption driving loss of nature and biodiversity in other regions	Increase the proportion of sustainably sourced materials in public procurement	Increase the % of urban development located near protected areas that include measures to protect and enhance nature to X % by 2030	Materials to which the procurement policy will apply (tick box list) Certification schemes that will be used (tick box list of major existing schemes)	
Urban consumption driving loss of nature and biodiversity in other regions	Reduce the consumption of resource intensive materials	Reduce the % of meat consumed at events organised or supported by the local authority, public schools and hospitals by X over 2020 – 2030 Reduce the % of concrete used in new housing developments by X over 2020 – 2030		
Enhancing public knowledge and values for nature	Increase the proportion of urban residents who have access to meaningful experience of nature	Ensure that X % of children in the city have opportunities for direct experience of nature each year	Total number of children in the city (tick boxes of ranges)	
Enhancing public knowledge and values for nature	Increase the proportion of urban residents reached by education/communication related to the presence and value of nature in the city and actions they can take to protect it	Ensure that X % of city residents are reached by public education campaigns related to the importance and value of nature in the city and the actions they can take to protect it	Total number of residents in the city (tick boxes of ranges)	

Table 2: Restoration (5 goals)

Issue / Driver / Lever (science-based as derived from IPBES / Naturvation evidence base)	Potential target (designed to relate to urban experience and practice)	Formulation (SMART)	Tags (additional tick boxes required on web data entry form)	Associated Goals (additional tick boxes required on web data entry form)
Undertaking restoration of degraded habitat	Proportion of degraded habitat restored to ecological value	Increase the % of degraded habitat Y (e.g. rivers, contaminated land, coastal ecosystems) in the city restored to X% over 2020 – 2030/50	City is located in a biodiversity hotspot (list provided to tick) Natural habitats included in calculation (terrestrial, rivers, marine) (check boxes)	
Recreating habitats	Proportion of habitat recreated	Increase the % of habitat Y (e.g. restoring riverbanks, daylighting rivers, wildflower meadow) in the city by 2030/50	City is located in a biodiversity hotspot (list provided to tick) Natural habitats included in calculation (terrestrial, rivers, marine) (check boxes)	
Recreating habitats	Recreation or restoration of habitat for protection and enhancement of specific species	Increase the % of habitat Y for species A in the city by X% over the period 2020-2030/50 (e.g. pollinator gardens)	City is located in a biodiversity hotspot (list provided to tick) Type of species (bird, mammal, fish etc tick boxes provided) Status of species (red list, rare, important local value etc. tick boxes)	
Species restoration	Restoration of species through habitat enhancement (e.g. bird boxes, bee hives, insect homes etc.)	Increase the % of species A in the city by X% over the period 2020-30/50	City is located in a biodiversity hotspot (list provided to tick) Type of species (bird, mammal, fish etc tick boxes provided) Status of species (red list, rare, important local value etc. tick boxes)	
Enhancing public knowledge and values for nature	Increase the proportion of urban residents reached by education/communication related to the actions the can take to restoring habitats and species	Ensure that X % of city residents are reached by public education campaigns related to the actions they can take for restoring nature	Total number of residents in the city (tick boxes of population amounts)	

Table 3: Thrive (15 goals)

Issue / Driver / Lever (science-based as derived from IPBES / Naturvation evidence base)	Potential target (designed to relate to urban experience and practice)	Formulation (SMART)	Tags (additional tick boxes required on web data entry form)	Associated Goals (additional tick boxes required on web data entry form)
Social Well Being	Proportion of urban residents within 10-minutes walk of urban green space	Increase the % of residents with access to green space within a 10-minute walk by X% over the period 2020-2030/50 Increase the % of residents from the most economically deprived parts of the city with access to green space within a 10-minute walk by X% over the period 2020-30/50	Total Ha Urban Green Space (ranges given in tick boxes) Total Population (ranges given in tick boxes)	
Social Well Being	Proportion of urban residents involved in the design and stewardship of urban green space	Increase the % of residents involved in the design and stewardship of urban green space by X% over the period 2020-2030/50 X% over the period 2020-2030/50 Increase the % of residents from the most economically deprived parts of the city involved in the design and stewardship of urban green space by X% over the period 2020-2030/50 X% over the period 2020-2030/50 Increase the % of marginalised residents (e.g. youth, women, migrants, informal dwellers, indigenous groups) involved in the design and stewardship of urban green space by X% over the period 2020-2030 50 X% over the period 2020-2030/50		
Social Well Being	Proportion of urban land used to provide space for community gardens	Increase the % of urban land provided for community gardens by X% over the period 2020 – 2030/50 Increase the % of urban land in community ownership for the provision of community gardens by X% over the period 2020-2030/50		

Issue / Driver / Lever (science-based as derived from IPBES / Naturvation evidence base)	Potential target (designed to relate to urban experience and practice)	Formulation (SMART)	Tags (additional tick boxes required on web data entry form)	Associated Goals (additional tick boxes required on web data entry form)
Cultural Activities & Heritage	Proportion of urban residents with access to green space for recreation	Increase the % of residents with access to green space for recreation by X% over the period 2020-2030/50 Increase the % of residents from the most economically deprived parts of the city with access to green space for recreation by X% over the period 2020-30/50		
Cultural Activities & Heritage	Proportion of heritage sites that explicitly protect their natural heritage	Increase the % of heritage sites in the city that explicitly undertake to protect their natural heritage by X% over the period 2020-2030/50		
Cultural Activities & Heritage	Proportion of urban residents who are provided with opportunities to connect with & spend time in nature	Increase the % of urban residents who visit urban green space and heritage sites in the city by X% over the period 2020-30/50 Increase the % of residents from the most economically deprived parts of the city who visit urban green space and heritage sites in the city by X% over the period 2020-30/50 Increase the % of marginalised residents (e.g. youth, women, migrants, informal dwellers, indigenous groups) who visit urban green space and heritage sites in the city by X% over the period 2020-30/50		
Economic development	Number of employment opportunities created through working with nature in the city	Increase the number of employment opportunities connected to the conservation, restoration and recreation of nature and associated with increasing opportunities for tourism, recreation and well-being by X% over the period 2020-30/50		
Economic development	Reduce the costs of managing and maintaining urban infrastructure through the use of nature-based solutions	Reduce the costs of maintenance, loss and damage of urban infrastructure through using nature-based solutions by X% over the period 2020-30/50		
Economic development	Increase the value of urban land through integrating nature into urban design and development	Increase the value of urban development in the city through integrating nature and nature-based solutions into the design and implementation of urban development projects by X% over the period 2020-30/50		
Climate protection	Increase the carbon sequestration potential of urban nature	Increase carbon sequestration in the city by X% above 2020 levels by 2030/50		

Issue / Driver / Lever (science-based as derived from IPBES / Naturvation evidence base)	Potential target (designed to relate to urban experience and practice)	Formulation (SMART)	Tags (additional tick boxes required on web data entry form)	Associated Goals (additional tick boxes required on web data entry form)
Climate protection	Increase resilience through working with nature	Increase the % of coastal habitat designed to deliver coastal protection by X% above 2020 levels by 2030/50 Increase the % of sustainable urban drainage systems being used in the city by X% above 2020 levels by 2030/50 Increase the % of green roofs being used in the city by X% above 2020 levels by 2030/50		
Climate protection	Reduce the urban heat island effect	Reduce the number of days in excess of Y temperature for X% of urban residents through increasing the use of nature for shade and cooling Increase the use of nature for cooling the city by X% above 2020 levels by 2030/50		
Environmental quality	Increase the capacity of nature in the city to reduce air pollution	Increase the % of planting in the city with the capacity to reduce air pollutants by X% above 2020 levels by 2030/50 Ensure that X% of streets with a high pollution load are planted with species that can reduce air pollutants by 2030		
Environmental quality	Increase the capacity of nature in the city to reduce water pollution	Increase the % of rivers in the city using nature-based solutions to reduce pollution and enhance water quality by X% above 2020 levels by 2030/50		
Environmental quality	Increase the capacity of nature in the city to remediate soil	Increase the use of nature in soil remediation in the city by X% over the period 2020-2030/50		

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