

Ecosystem services in cities: towards the international legal protection of ecosystem services in urban environments

Authors: Aysegül Sirakaya (PhD Researcher, Ghent University), An Cliquet (Associate Professor, Ghent University), Jim Harris (Professor, Cranfield University)

Corresponding Author: Aysegül Sirakaya, PhD Researcher at Ghent University

E-mail : aysegul.sirakaya@ugent.be

Address: Ghent University, Faculty of Law, Department of International and European Law, Universiteitstraat 4, 9000 Ghent/Belgium

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Abstract

Biodiversity provides many ecosystem services in cities that are beneficial to human well-being including adaptation to the effects of climate change and positive effects of nature on human health. Rapid urbanization however is causing an adverse impact on biodiversity and the ecosystem services they provide. Protecting and restoring urban biodiversity and ecosystem services can increase human well-being of the rapidly increasing urban population. Today, however, the international biodiversity conservation practice mainly focuses on rural areas, and not on urban conservation and restoration. Within city scale, there are several opportunities to green urban living, such as green infrastructure and urban parks and nature reserves. This paper investigates the current scientific practices for promoting and protecting ecosystem services in urban areas. Secondly, the authors review and assess the legally binding instruments on biodiversity at international and EU level in order to see if there are sufficient existing mechanisms for protection of ecosystem services in urban areas. Thirdly, the paper elaborates on the Aichi Targets in order to explore whether or not these targets are enough to facilitate the protection and enhancement of ecosystem services in urban areas as swiftly as they are needed.

Highlights

- Protection and restoration of biodiversity in cities is key to providing ecosystem services in an increasing urbanized world.
- In recent years, international environmental law has recognized the important role that cities play in protecting biodiversity and providing ecosystem services.
- Technical guidance that focuses on the solutions for challenges of implementation of urban ecosystem restoration, is lacking at the international level.
- Legally binding requirements for international targets -rather than voluntary schemes at the national level- are vital for addressing urban challenges related to ecosystem services coherently and progressively.

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3 1. Introduction
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7 Biodiversity in cities can provide many ecosystem services beneficial to human well-being and
8 human health. Rapid urbanization creates both challenges and opportunities for biodiversity and
9 ecosystem services. Conserving and restoring biodiversity in cities is a key element for reaching
10 sustainability goals and can help reverse the ongoing biodiversity crisis. This paper examines the
11 international legal and policy framework for the protection of biodiversity and ecosystem services in
12 cities. The paper first analyses why biodiversity and ecosystem services in urban environments are
13 so important, and why they should be conserved or restored (section 2). The protection of urban
14 biodiversity and ecosystem services is situated at multilevel scales and includes legal and policy
15 commitments ranging from the international global, regional, national to a local city level. This paper
16 will focus on international global commitments and will briefly mention some international regional
17 examples as well. Rapid urbanization and the impact it has on biodiversity is a worldwide concern,
18 and although the answers to solving this challenge can have regional and local differences, global
19 commitments are the main starting point. In general, urban ecosystems are not explicitly excluded
20 from international legal binding documents. In recent years they have become a focus of attention in
21 several non-binding soft law documents, such as the decisions from the Conference of Parties (COP)
22 to the Convention on Biodiversity and other multilateral or regional environmental agreements.
23 Section 3 will examine the legal commitments under the Convention on Biodiversity and the Ramsar
24 Convention. It will also briefly look into two regional examples, namely the European Bern
25 Convention and EU law. Section 4 of this paper will examine the Aichi Targets to the Biodiversity
26 Convention with regards to their relevance to urban nature conservation and restoration.
27 Specifically, the paper will elaborate on Targets 14 and 15 in relation to urban biodiversity and
28 ecosystem services, and provide the results of an analysis of the national biodiversity strategy and
29 action plans (NBSAP) under the Convention, specifically relating to urban biodiversity.
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36 2. The importance of urban biodiversity and urban ecosystem services
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38 Biological organisms are the central agents in the functioning of ecosystems, and the diversity of
39 these organisms (biodiversity hereafter) has profound influence of this function (Hooper et al.,
40 2005). This biodiversity, along with the stocks of abiotic materials and their disposition and
41 interactions are known as “Natural Capital”, which is dependent on biodiversity (Balvanera et al.,
42 2006) and delivers human well-being (Millennium Ecosystem Assessment, 2005). There are several
43 compelling reasons for preserving and restoring biodiversity which go beyond simple utility
44 (Pearson, 2016) and continuing losses will have adverse effect on ecosystem function and therefore
45 degrade ecosystem service flows (Cardinale et al., 2012).
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48 Urban areas are usually developed in areas of high biodiversity, as humans tend to establish
49 settlements around where most natural resources are (Cincotta et al., 2000; Luck, 2007; Macdonald
50 et al., 2008) and consequently management for the conservation of biodiversity, especially with
51 regards to expansion and new developments (e.g. Pauchard et al., 2006) is crucial if we are to avoid
52 further biodiversity loss (McKinney, 2006) as well as increased effects of climate change in urban
53 areas. Urbanization is a major cause of biotic loss and homogenisation, maintained for centuries in a
54 state by suppression of natural processes. The import of non-native species can replace native flora
55 and fauna, which is particularly acute if the species are invasive (McKinney, 2006). However, urban
56 species are very often abundant and diverse – allowing for effective conservation and restoration
57 interventions. The current world urbanization prospects stipulate that 66% of the global population
58 will live in cities by 2030 (UN, 2014). Continuing rapid urbanization will be a major challenge to
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1 protected areas and biodiversity conservation, and require thoughtful planning, monitoring and
2 regulation (McDonald et al., 2008; Haaland et al., 2015). Even those cities with an explicit “Green”
3 agenda in their planning regulations have struggled to maintain green to built infrastructure ratios
4 with appropriate character and fragment sizes (e.g. Tan et al., 2013). This is important as green
5 infrastructure is where most of the Natural Capital of urban areas is to be found, in terms of the
6 primary producers (plants) upon which ecosystem function is based. It is from this that the principal
7 “ecosystem services” are derived – supporting, regulating, provisioning, and cultural. The situation
8 in urban areas is complex as, for example, tall buildings can provide nesting sites for top level
9 predators (e.g. peregrine falcons) and built structures can provide regulation services (e.g. flood
10 control). Also, there are urban areas where there are large “hybrid” urban-rural components (e.g.
11 European Parliamentary Research Service, 2016). It has been suggested that there is a distinct
12 biogeochemistry (Kaye et al., 2006) and that there are complex mixes of the natural-unnatural
13 spectrum dependant on each cities’ layout. Clearly, the natural components of urban areas,
14 delivered by biodiversity, can provide ecosystem services *in situ*, such as carbon sequestration, flood
15 mitigation, aesthetic pleasure and pollination. Ziter (2016) has reviewed the role of biodiversity in
16 delivering ecosystem services in urban areas and has found that most studies have focussed on the
17 relationship between biodiversity and regulating services – which were found to be dependent on
18 composition of species, functional groups, or their inter-relationships in communities.

21 Nature can play a significant role in maximising the benefits and minimising the negative effects of
22 urban living, and the Natural Capital–ecosystem services framework has provided a basis for
23 understanding these benefits and has been used to inform decisions as to which policy options (e.g.
24 urban planning, green infrastructure) might maximise well-being outcomes (e.g. Salmond et al,
25 2016), and increase resilience to environmental risks (e.g. Kabisch et al, 2016). Nature and
26 biodiversity in cities provide numerous ecosystem services (Szlavetz et al., 2011). Stimulating or
27 restoring ecosystem services in cities can be effective solutions for both climate change adaptation
28 and mitigation (Dover, 2015; European Commission, 2015). Urban ecosystem services do this by
29 providing cool air to cities which leads to reduction in energy consumption particularly in the
30 summer. Restoring local wetlands can result in the prevention of disease and natural disaster to a
31 great extent (SCBD, 2012). Urban ecosystem services improve the air and water quality and thus
32 provide a more resilient urban living to locals. Urban ecosystem services can also improve the social
33 inclusion in a city and provide public space for activities and leisure (Millennium Ecosystem
34 Assessment, 2005). Chiesura (2004) identified the crucial role that urban parks play in securing
35 sustainability, through both direct biophysical links to health, and to psychological well-being
36 through exposure to nature (e.g. Shanahan et al., 2015; Soga et al., 2015). In a recent systematic
37 review, van den Berg and colleagues (2015) demonstrated strong evidence for significant positive
38 associations between the quantity of greenspace and perceived mental health and all-cause
39 mortality, and moderate evidence for an association with perceived general health. Haase and co-
40 workers (2014) have carried out a quantitative review of how ecosystem services are assessed in
41 urban areas. They conclude that although a wide range of approaches have been taken, covering
42 many studies including biophysical models, geographical information systems (GIS), and valuation,
43 there is little evidence that there has been significant take up in land use policy.

49 The empirical evidence for this and the wider benefits of urban nature has been steadily accruing in
50 recent years and a clearer picture is emerging as to not only the importance of individual elements
51 of Natural Capital but also how the integration, feedbacks and interdependencies of the grey-green-
52 blue infrastructure of our urban areas are essential for securing sustainability. Certainly, it has been
53 possible to demonstrate that the presence of “natural” features (such as trees, hollow and decaying
54 logs, ground and mid-storey vegetation) are beneficial and their loss leads to degradation of well-
55 being (Le Roux et al., 2014). Urban habitats may contain, in addition to alien species, many endemic,
56 rare and endangered species but in pockets of refugia disconnected from the wider landscape. Still
57 there are opportunities for providing ecosystem service and biodiversity benefits beyond the city
58 (Kowarik, 2011). In particular, large old trees need special protection in urban areas, as single
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1 specimens in isolation, but also as part of parks and reserves (Lindenmayer, 2014). There are many
2 active research programmes aimed at mapping the ecosystem services arising from these
3 interactions, and the models being produced are increasingly accurate at mapping multiple services
4 (e.g. Grafius et al., 2016): this is essential if decision making at the scale of the level of the street and
5 household are to be made (Gret-Regamey et al., 2015).

6 There are undoubtedly challenges to securing and enhancing urban ecosystem services, which have
7 been clearly outlined by Luederitz et al. (2015). These are:

- 8 1. *Comprehensive spatial and contextual coverage of research* – most work is currently
9 concentrated in the developed countries of the northern hemisphere, whereas some of the
10 most acute problems of rapid urbanization occur in Low and Middle Income Countries
11 (LMICs), with tropical climates, and very different natural ecosystem starting points. Often
12 studies also give no population size/area context, making transferability and generalisation
13 difficult or impossible.
- 14 2. *Clarification of definitions* – particularly around the definition of “urban” which requires
15 unambiguous description of the environmental, spatial and socio-economic context. This
16 includes the problem of “city limits” – you can have a large “green city” by extending the city
17 limits to include “natural” areas, but with no benefits for urban dwellers at the core.
- 18 3. *Limited transferability of data* – global estimates of services and values cannot easily be
19 transferred to local contexts, due to differences in biomes and socio-economic
20 circumstances.
- 21 4. *Stakeholder engagement* – few studies involve stakeholders (20% or fewer according to
22 Luederitz et al.’s findings), leading to the danger that the process could become
23 technocratic, and there is an urgent need for engaging stakeholders in ecosystem service
24 research.
- 25 5. *Integrated research effort* – there is a need for trans-disciplinarity in the research effort,
26 otherwise it will be impossible to capture the full diversity and richness of ecosystem service
27 provision by green infrastructure (Potschin and Haines-Young, 2011).
- 28 6. *Closing the feedback loop between urban ecosystem service appropriation and the
29 management of urban ecological structures* – research and assessment has to be properly
30 connected to the management of urban ecological components within the green
31 infrastructure, and the management regimes, actors and regulations. Without this there is
32 little prospect of translating research findings into action on the ground.

33 These gaps are legion, but offer rich opportunities for understanding within and between disciplines
34 in many fields – and a solid agenda for providing impact in real lives in the places where most people
35 live.

36 Conservation and restoration of Natural Capital, and therefore ecosystem services flowing from it, in
37 urban areas can reduce their ecological footprints and enhance resilience, health and the quality of
38 life of inhabitants – and these values can be captured by a variety of means (Gomez-Baggethan and
39 Barton, 2013; Shaffler and Swilling, 2013). This requires a blend of socio-economic and ecological
40 analysis and understanding, synthesised as a result of open and frank trans-disciplinary work. It is
41 therefore logical that, by investing in green infrastructure and Natural Capital, we should improve
42 ecosystem services flows and positive well-being outcomes. Elmqvist and co-workers (2015) have
43 demonstrated that investing in the ecological infrastructure in the USA, Canada and China, has
44 resulted in monetary benefits, in addition to the already recognised ecologically and socially
45 desirable improvements. Protecting and restoring urban biodiversity and Natural Capital has to be
46 taken into the public planning, legislative and regulatory regime. The next sections will examine
47 whether international law and policy provides an adequate legal basis to do so.

3. Legal obligations for protecting and restoring urban ecosystem services

3.1. Legal obligations at multilevel scales

Although many cities are already taking initiatives to protect or restore urban ecosystem services (e.g. SCBD, 2012), much more can and needs to be done, in light of the ongoing biodiversity crisis and urban sprawl and the interlinkages between both. The national or local legal framework, including zoning and planning legislation, biodiversity legislation and environmental legislation in general can all play an important role in facilitating and regulating the protection and enhancement of urban ecosystem services. Berlin's biotope mapping which started in the 1970s in order to map the biodiversity richness in the city is a good example of an enhanced national effort. This effort later turned into a legally binding planning arrangement called "Biotope Area Factor". The Biotope Area Factor aims to protect nature in the areas of development by establishing requirements on the percentage of green on and around buildings (<http://www.stadtentwicklung.berlin.de/>). Another example is Japan's 43-year-old Urban Green Space Conservation Act which aims to conserve, restore and create green spaces which provide precious ecosystem services by designating special green conservation areas (<https://www.cbd.int/doc/world/jp/jp-nr-05-en.pdf>). Some countries' laws such as Finland's does include urban conservation areas in general planning acts or conservation laws and do not regulate urban biodiversity separately (<https://www.cbd.int/doc/world/fi/fi-nr-05-en.pdf>).

National laws are however beyond the scope of this article. This paper will focus on the international legal framework. International law can provide the necessary impetus that States need in order to take the required measures to protect and enhance urban ecosystem services. Young (2011) argues that international environmental commitments such as in regulatory settings help to a great extent create willingness amongst Parties to act as prescribed. In other words, international governance often ends up strengthening commitments at the national level. Since urban biodiversity protection is a novel topic within the legal doctrine, it is therefore worthwhile to explore the attention that is given at the international level to urban biodiversity and ecosystem services, as this can be an illustration of the growing political willingness to tackle these issues, and can even amount to legally binding norms, at various geographical scales. Environmental law in general is often a complex mixture of international, regional hard and soft law, further implemented into national policies and laws. From a formal point of view, a distinction is made between hard law, in the form of binding international or regional conventions, and soft law, such as non-binding COP-decisions. It would be too simple to categorize the formal soft law instruments, such as most COP-decisions, as legally non-binding, and thus having no or little legal effect. Both international hard and soft law can influence laws and policies at the regional and national level. COP-decisions can also be used as an interpretation of hard law obligations in a convention (Verschuuren, 2008). Not only the form of the document is important in this regard, but also the language used (obligatory or stimulating), as well as implementation mechanisms (ranging from judicial mechanisms to reporting to international bodies). In the following sections the current legal obligations in international law will be examined. A subsequent section 4 will look at concrete targets that have been set in international environmental law. The focus will be on the protection and restoration of biodiversity in cities, as ecosystem services depend on well-functioning ecosystems and biodiversity, as was pointed out in the section 2. As such, international law on - for example - water pollution or air pollution will not be dealt with, although undoubtedly these legal instruments can contribute to the protection of urban ecosystem services.

The instruments that are examined are limited to the Convention on Biological Diversity (CBD, 1992), and the Ramsar Convention (1971) and the subsequent decisions by the Conference of Parties (COP).

1 At the regional level, both the Bern Convention (1979) and the EU nature legislation will be briefly
2 explored. Although the focus of many international biodiversity conventions is predominantly aimed
3 at the protection of the rural environment, it as such does not exclude the protection of biodiversity
4 in cities.

5 6 3.12 Biodiversity Convention

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8 The Biodiversity Convention in its Article 2 defines “biological diversity” as “the variability among
9 living organisms from all sources including, inter alia, terrestrial, marine and other aquatic
10 ecosystems and the ecological complexes of which they are part; this includes diversity within
11 species, between species and of ecosystems.” Although urban biodiversity is not mentioned
12 explicitly, the definition does not exclude it. As a consequence, the legal obligations of the
13 Convention, such as those provided in Article 8 on *in situ* conservation also apply to urban
14 ecosystems and biodiversity. However, it is only in recent years that explicit attention has been paid
15 to urban biodiversity. The role of cities in the implementation of the Convention is increasingly
16 recognized and from 2008 onwards, every COP meeting has paid some attention to the role of cities.
17 Cities are now seen as a major group and “the Parties to the CBD are increasingly seeking to engage
18 with subnational governments to accelerate and improve implementation of the Convention.”
19 (<https://www.cbd.int/subnational>). In several COP decisions, attention has been paid to the role of
20 cities in the protection of biodiversity and ecosystem services. While the responsibilities for
21 implementation of the Convention rest primarily with the State Parties, the engagement of cities is
22 recognized. State Parties are therefore encouraged to recognize the role of cities and local
23 authorities in their national biodiversity strategies and action plans and to support the development
24 of local biodiversity strategies and actions plans (SCBD, 2008). In 2010 the most elaborate document
25 was accepted in a COP decision, by adopting a Plan of Action on Subnational Governments, Cities
26 and Other Local Authorities for Biodiversity (CBD, 2010c). The mission of the Action Plan is to engage
27 cities in achieving the objectives of the Convention and the implementation on the Strategic Plan for
28 Biodiversity 2011-2020, including an indicative list of actions, as well as measures for monitoring and
29 reporting. The Action Plan supports tools such as the Singapore Index on Cities’ Biodiversity (CBI),
30 which is a self-assessment tool to help cities evaluate and monitor the progress of their biodiversity
31 conservation efforts. Under this index, 23 indicators were developed that measure native
32 biodiversity, ecosystem services provided by biodiversity and governance and management of
33 biodiversity. The Action Plan also mentions, albeit cautiously, funding opportunities for cities: Parties
34 may identify funding oriented specifically towards biodiversity at the local level.

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41 The Conference of Parties in 2010 asked the CBD Secretariat to prepare an assessment of the links
42 and opportunities between urbanization and biodiversity. The Cities and Biodiversity Outlook is the
43 first global analysis on the projected urbanization and the effects on biodiversity. This policy
44 document was prepared for the eleventh meeting of the Parties in 2012 (SCBD, 2012). At COP 11
45 Parties were invited to develop guidelines and capacity-building initiatives to develop, enhance or
46 adapt local biodiversity strategies and action plans. Parties, development organizations and other
47 donors were invited to support initiatives by networks of local governments, such as the ICLEI local
48 Action for Biodiversity Initiative. Parties were also encouraged to monitor and report on the
49 contribution of their cities to reaching the Aichi Targets, in particular in their fifth national reports
50 (see below, section 4) (CBD, 2012).

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54 In 2014 the Conference of Parties strengthened their intentions to cooperate with local
55 governments. Parties were invited to increase their efforts to enable, support and guide strategic
56 and sustainable urbanization by working together with local governments for achieving the Aichi
57 Targets. Parties were asked to incorporate biodiversity considerations into their urban, peri-urban,
58 land-use and infrastructure planning, such as green infrastructure. The COP Decision also addressed
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1 local governments themselves by encouraging them to contribute to the implementation of the
2 Biodiversity Strategic Plan 2011-2020 (CBD, 2014).

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4 Whereas the Biodiversity Convention has recognized the importance of cities in the implementation
5 of the Convention, also cities have acknowledged the role they can play in implementing the
6 Biodiversity Convention, for instance by the Curitiba Declaration on Cities and Biodiversity (2007),
7 strengthened by the Second Curitiba Declaration in 2010. At the City Biodiversity Summit in 2010 the
8 Aichi/Nagoya Declaration on local authorities and biodiversity was accepted. These documents,
9 although legally non-binding, all confirm the commitments of the signatories to contribute actively
10 to the implementation of the Biodiversity Convention. In the Aichi/Nagoya Declaration, cities
11 supported the Action Plan that was established by COP Decision IX/28.
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13 14 15 3.3. Ramsar Convention

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17 The Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat
18 does also not exclude wetlands in urban areas. The focus of the Convention was for a long time on
19 wetlands in rural areas. The explicit attention for wetlands in urban environments is fairly recent and
20 was formally recognized by Resolution X.27, adopted at the Conference of Parties in 2008 (Ramsar,
21 2008). The Resolution recognized that wetlands in urban and peri-urban environments can deliver
22 many important ecosystem services to people, and that urban green and blue space is increasingly
23 known to contribute to people's physical and mental health and well-being. Parties are therefore
24 urged to pay attention to the importance of their wetlands in urban and peri-urban environments
25 and to take appropriate measures to conserve and protect these wetlands. States should review the
26 state of these environments and put in place schemes for their restoration and rehabilitation, so
27 that they can deliver their full range of ecosystem services to people and biodiversity. In 2012,
28 principles for planning and management of urban and peri-urban wetlands were established by
29 Resolution XI.11 (Ramsar, 2012). Parties are urged to consider principles for policy development and
30 implementation, and practical principles for wetland conservation and restoration. The appendix to
31 the Resolution identifies key issues facing wetlands from pressures associated with urbanization, as
32 well as a number of potential solutions to overcome these issues.
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35 In 2015, a COP Resolution provided a voluntary Wetland City Accreditation framework, establishing
36 criteria that a city must fulfil in order to get accreditation. The accreditation would encourage cities
37 that are close to and depend on wetlands to establish a positive relationship with these wetlands
38 through increased participation and awareness and consideration of wetlands in local planning and
39 decision making (Ramsar, 2015). However, the accreditation does not confer any legal rights or legal
40 obligations on the city or the Party to the Convention.
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43 Although the recent attention for urban wetlands under the Ramsar framework is certainly
44 recommendable, the regime falls short on specific technical guidelines for specific urban challenges
45 such as fragmentation and urbanization of wetland watersheds (Hettiarachchi, 2015).
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47 48 49 3.4. Examples of regional instruments: The Bern Convention and EU law

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51 Also in regional environmental law, recent attention has been given to urban biodiversity and urban
52 ecosystem services. Two examples are briefly discussed: The European Bern Convention and EU
53 biodiversity laws and policy.
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56 The Bern Convention on the Conservation of European Wildlife and Natural Habitat (1979), under
57 the auspices of the Council of Europe, aims for the protection of wild flora and fauna in Europe.
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1 Bern Convention is a regional biodiversity convention, with a broad scope and some interesting
2 characteristics, including mostly strict obligations and an implementation mechanism (Jen, 1999;
3 Diaz, 2010; Bowman et al., 2010; Trouwborst, 2011, 2016).

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5 It served as the basis for the EU Nature Directives. Although the Convention as such does not
6 explicitly address urban biodiversity in the Convention text, the Convention framework and
7 institutional framework enable further interpretation and directions for the implementation of the
8 Convention. The Standing Committee of the Bern Convention supported a Recommendation by the
9 Congress of Local and Regional Authorities of the Council of Europe, on Biodiversity policies for
10 urban areas (Congress of Local and Regional Authorities, 2008). In this Recommendation a number
11 of recommendations were made to the Committee of Ministers of the Council of Europe, including
12 that biodiversity should become a political priority in all Member States of the Council of Europe and
13 the need to take account of the specificity of urban biodiversity in the struggle against biodiversity
14 loss. The Standing Committee of the Bern Convention in its turn noted that urban biodiversity should
15 be fully addressed in all biological diversity instruments, strategies and action plans. Issues relevant
16 for urban biodiversity that are dealt with by the Standing Committee include invasive alien species,
17 the conservation of wild species and the impacts of climate change (Standing Committee, 2008).
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21 In the European Union, the Bern Convention has been implemented by the EU Nature Directives
22 (Birds Directive, 2009; Habitats Directive, 1992). The Nature Directives provide a prime example of
23 strong nature conservation legislation and are considered to be European nature's best hope (Born
24 et al., 2015). The Nature Directives can apply to the protection and restoration of biodiversity in
25 cities, especially in a strongly urbanized region as Europe. Although the Natura 2000 network, which
26 is an ecological network of protected areas under the Directives can predominantly be found in rural
27 areas, several cities include Natura 2000 sites (Sundseth & Raeymaekers, 2006). Strict species
28 provisions apply on the whole territory, thus including cities. Article 10 of the Habitats Directive
29 obliges Member States to protect landscape features which are of major importance for wild fauna
30 and flora and include linear elements (such as rivers with their banks or the traditional systems for
31 marking field boundaries) or stepping stones (such as ponds or small woods). The EU policy on Green
32 Infrastructure is of particular importance for urban biodiversity and ecosystem services. Green
33 Infrastructure is defined as "a strategically planned network of natural and semi-natural areas with
34 other environmental features designed and managed to deliver a wide range of ecosystem services.
35 It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical
36 features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban
37 settings." (European Commission, 2013).
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44 All of the above mentioned international and regional environmental law instruments show the
45 recent attention for urban biodiversity and the ecosystem services that urban biodiversity provides.
46 On the one hand the importance of urban biodiversity is recognized, and on the other hand, the role
47 of cities in the protection and restoration of biodiversity and the ecosystem services it provides, is
48 recognized. The above mentioned initiatives are mostly taken in the form of legally non-binding COP
49 decisions (under multilateral or regional Conventions) or policy (such as the EU Green Infrastructure
50 policy). Most of these initiatives remain rather vague and do not set concrete targets for the
51 protection and restoration of urban biodiversity and ecosystem services. Also, most initiatives rely
52 on the implementation at the national level, through national or local biodiversity strategies and
53 action plans. The next part explores the concrete international targets that have been set at the
54 international level and that are relevant for urban biodiversity. It explores and discusses if and to
55 what extent these targets have been translated for urban biodiversity and ecosystem services into
56 national action plans.
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4. International targets for protecting and restoring urban ecosystem services

The scope of this article with regards to the international targets goes as far to elaborate on the Aichi Targets under the Biodiversity Convention, as the Aichi Targets solely focus on the protection of biodiversity, and they provide the most thorough and clear indication on urban biodiversity conservation as well as the national strategies and action plans. The United Nations Sustainable Development Goals also include targets on ensuring the sustainability of the cities (Goal 11) and restoring ecosystem services in order to halt biodiversity loss (Goal 15). Nevertheless, the Sustainable Development Goals are today at their infancy, and there is not yet a clear indication on urban biodiversity conservation. Neither there yet exists information on national implementation. Today, the discussion on urban areas focuses specifically on urban pollution -with a specific emphasis on air pollution- and urban-rural linkages (UN ECOSOC E/2016/75, 2016; UN A/70/472, 2015).

The Aichi Targets stem from the Strategic Plan of the Decision X/2 of the COP to the Convention on Biological Diversity (CBD). The Aichi Targets replace the unmet 2010 Biodiversity Targets (CBD, 2010b; SCBD, 2010; Tollefson et al., 2012). The overall mission of the Strategic Plan is to “take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services, thereby securing the planet’s variety of life, and contributing to human well-being and poverty eradication”. The Strategic Plan consists of 5 strategic goals and 20 corresponding targets, the Aichi Targets. The targets related to ecosystem services are listed under strategic goal D.

The COP Decision X/2 stipulates that the implementation of these targets will be facilitated through national and subnational activities, i.e. via Parties’ national biodiversity strategies and action plans (CBD, 2010b). The parties are to report the progress on national implementation of the Aichi Targets by means of their 5th and 6th national reports. Review of the midterm progress of these targets is facilitated through the 4th edition of the Global Biodiversity Outlook (GBO).

Decision X/2 on the Aichi Targets is followed by the above mentioned Decision X/22 on the Plan of Action on Subnational Governments, Cities and Other Local Authorities for Biodiversity, which aims for better provision of ecosystem services for urban dwellers and incorporation of biodiversity concerns into urban planning and development by 2020 (CBD, 2010c). Pursuant to Decision X/22, the Cities Biodiversity Outlook (CBO) document has been published under the facilitation of the Secretariat of the Convention on Biological Diversity (SCBD). The report incorporates 10 key messages, many of which relate to the importance of urban ecosystem services restoration (CBD, 2012). It furthermore provides guidance and awareness on the importance of urban ecosystems restoration in order to contribute to climate change mitigation and adaptation. Within this context, the CBO acknowledges the importance of the restoration of urban ecosystem services in order to attain to Aichi Targets 14 and 15. The scope of this paper will therefore cover target 14 and 15 as these two targets are utmost related with urban ecosystem services.

4.1. Target 14

Aichi Target 14 aims to restore and safeguard essential ecosystem services that contribute to health, livelihoods and well-being by 2020 (CBD, 2010b). This is to be done by taking into account the needs of women, indigenous and local communities, and the poor and vulnerable. The CBO argues that

1 maintaining urban ecosystem services can significantly improve human health and well-being (CBD,
2 2012). The Biodiversity Indicators Partnership goes one step further and states that health and well-
3 being of communities are directly dependant on the local ecosystem services (Tyrrell et al., 2014).
4 Consequently, ecosystem services restoration, taking into account the well-being of local
5 communities and many vulnerable groups, will unavoidably require ecosystem services restoration
6 in urban areas. Ecosystem services self-reliance could be one of the key aspects for urban
7 sustainability (Wu, 2014) as well as a sound solution for addressing target 14.
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10 11 12 13 4.2. Target 15 14

15 The objective of Aichi Target 15 includes contributing to climate change mitigation and adaptation
16 by restoring at least 15% of the degraded ecosystems (CBD, 2010b). Considering what has been said
17 in section 2 of this article on the contribution of cities to climate change via greenhouse gas
18 emissions and the negative impacts of climate change on the cities and their dwellers, urban
19 ecosystems restoration will be of crucial need. Previously mentioned examples from the practice
20 further demonstrates that urban ecosystem services restoration can help to a great extent achieve
21 the objectives of Target 15 (CBD, 2012).
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24 25 4.3. Assessment of implementation by reviewing the national reports 26

27 Under Article 26 of the CBD, each Party to the Convention is to develop a national report on
28 measures it has taken so as to implement the provisions of the Convention. These reports are
29 accompanied by the national biodiversity strategy and action plans (NBSAP). During the fifth COP
30 meeting, Parties agreed that the reports would be submitted in a periodical manner; once in every
31 four years. National reports are indispensable instruments for the implementation of the Strategic
32 Plan for Biodiversity 2011-2020 (CBD 2010b) as they indicate the progress towards the Aichi Targets
33 undertaken by the COP. This is evident in the methodology used for the fourth edition of the GBO
34 (GBO-4) regarding the progress towards the Aichi Targets as well as the evaluation of the mid-term
35 outcomes on the succession of the Strategic Plan (SCBD, 2014). The GBO-4 bases its assessment on
36 the fifth national reports. The deadline for submission of the latter decided under COP Decision X/10
37 was 31 March 2014 (CBD, 2010a). However, not all countries have submitted their reports by then.
38 Therefore, the GBO-4 only includes reports from 64 Parties (SCBD, 2014). Until May 2016, 115
39 additional reports have been submitted by the Parties. This section will therefore assess the fifth
40 national reports of 181 Parties to the CBD in order to evaluate the progress towards the
41 achievement of Aichi Targets 14 and 15. The section will specifically map the current state of
42 progress of the Parties towards the restoration of urban ecosystem services (target 14) and
43 ecosystem services restoration in urban areas for climate mitigation and adaptation (target 15). It
44 should be noted however that due to language barrier, 8 out of 181 national reports could not be
45 assessed.
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50 Under their fifth individual national reports, nine Parties (China, Finland, Germany, Japan, Republic
51 of Korea, Malta, Norway, Philippines, Singapore) both thoroughly acknowledge the value of urban
52 ecosystem services and include urban ecosystem services in their restoration targets in
53 correspondence to the Aichi Targets 14 and 15 respectively. These countries' reports focus, to a
54 great extent, on the urban ecosystem services and urban restoration and conservation. Fourteen
55 Parties (Algeria, Canada, Estonia, Haiti, India, Israel, Italy, Kenya, Lao, New Zealand, Poland, Solomon
56 Islands, Sri Lanka, The United Kingdom) acknowledge the value of urban ecosystem services and
57 include it in their national targets. Three of the Parties (Belgium, Denmark and Tunisia) acknowledge
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1 urban ecosystem services but do not include them in their targets. Eleven of the Parties (Australia,
2 Austria, Brazil, Cameroon, Congo, Costa Rica, Guyana, Monaco, Niger, South Africa, Tonga) do not
3 refer to the term urban ecosystem services but have several conservation and restoration targets in
4 urban areas. Eighteen Parties (Azerbaijan, Benin, Chile, Djibouti, Bosnia Herzegovina, France, Iraq,
5 Lebanon, Madagascar, Moldova, the Netherlands, Nigeria, Peru, Romania, Spain, Sweden,
6 Switzerland and Tajikistan) somewhat acknowledge and refer to urban ecosystem services. The
7 European Union, in its report, does not specifically acknowledge urban ecosystem services but often
8 refers to green infrastructure, in general. Eight of the signatory Parties' fifth national reports could
9 not be assessed due to the language barrier. The remaining 118 national reports neither refer to
10 urban ecosystem services, nor do they have national targets on urban biodiversity conservation or
11 restoration of urban ecosystem services. Nonetheless, a general consensus is present regarding the
12 fact that urban sprawl is one of the biggest threats to biodiversity.
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14 4.4. Discussion 15

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17 This analysis demonstrates that the majority of the signatory Parties' national reports do not
18 recognise biodiversity or ecosystem services in their urban settings. They furthermore do not have
19 any strategic plans or targets for conservation of nature in urban areas. It should be noted that the
20 COP Decision X/10 does not oblige the countries to develop a national target for each of the Aichi
21 Targets, if they have already reached the threshold of some of the targets, or if a certain target is not
22 relevant in the country context (CBD, 2010a). In this perspective, an assumption can be made on the
23 fact that these 106 countries do not include such concerns either because they do not have high
24 levels of urbanization or that they are already beyond the goal of Aichi Target 15 on restoration.
25 Indonesia is one of the countries that do not have concerns on urban ecosystem services under their
26 national report. Nevertheless, 53% of Indonesia's population is urbanized and this number will reach
27 70% by 2050 (UN, 2015). Likewise, the national report of Bangladesh does not include any input on
28 urban ecosystem services or urban restoration and conservation; however, Bangladesh is one of the
29 most rapidly urbanizing least developed countries with high pollution levels in urban areas (Marlier
30 et al., 2016). These factors demonstrate that not all of these 106 countries have no essential need in
31 urban ecosystem services or restoration in urban areas.
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34 Since the reason for not including urban ecosystem services concerns in the majority of the Parties'
35 national reports is not likely to be either of the abovementioned reasons, another reason may be
36 that there are no concrete targets at the urban level. One of the objectives of the Subnational Action
37 Plan is "to encourage and support local authorities to manage biodiversity sustainably, provide
38 ecosystem services to citizens and incorporate biodiversity concerns into urban planning and
39 development" (CBD, 2010c) by 2020. The mere fact that the majority of the Parties' lack of plans and
40 strategies supporting such provision and incorporation leads to the conclusion that the overall
41 efforts of the Subnational Governments have not resulted in achievement of these objectives within
42 the global scale.
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45 The solution for better implementation at the national level, can be facilitated through global
46 efforts. Schewenius and colleagues (2014) argue that one-size-fits-all approach cannot be the
47 solution for urban ecosystem services restoration. Nevertheless, they state that today many urban
48 areas face global challenges such as climate change or sea-level rise. Action and policy guidelines
49 under the CBO seem to support this argument, as it provides generalised guidelines for urban
50 biodiversity conservation and ecosystem services restoration.
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53 The verdict of the GBO-4 demonstrates that there is progress towards the targets 14 and 15 but at
54 an insufficient rate (SCBD, 2014). Similarly, with regards to the urban ecosystem recognition and
55 urban ecosystem services restoration, the assessment of this section shows that there is a
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1 developing understanding but nevertheless at an insufficient rate. Only one fourth of the countries
2 recognise the concept of urban ecosystem services and the importance of urban restoration at
3 variable levels.

4 Maxwell and colleagues (2015) argue that setting global targets can promote collaboration and
5 global agreement in a complex area such as ecosystems and their services. However, without further
6 agreeing on the details of these targets, specific methods and scope of implementation, they
7 stipulate that there remains a high risk of not attaining to the intended goal. Implementation of the
8 Aichi Targets depends on the States' individual actions (CBD, 2010b) and not on specific generalised
9 methods. Lack of action on urban ecosystem services restoration from the majority of the States is
10 highly likely to negatively affect the success of the Aichi Targets 14 and 15. In today's world in which
11 the urban growth is rapidly expanding to the world's most biodiversity rich areas (Güneralp et al.,
12 2013; Seto et al., 2012; Mcdonald et al., 2008), urban ecosystem services restoration could be one of
13 the most efficient solutions to attain to these targets. Even though the COP Decision X/22 as well as
14 the CBO strives to provide guidance and awareness on urban ecosystem services restoration in order
15 to attain to the Aichi Targets, stronger legal implication rather than encouragement remains
16 necessary for these targets to succeed.
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22 5. Conclusions

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25 This paper strived to demonstrate firstly the importance of biodiversity conservation in urban areas
26 with regards to the delivery of ecosystem services, and therefore the importance of promoting
27 ecosystem restoration in urban areas.
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29 Secondly, the article reviewed and assessed the implementation of the international and regional
30 legal instruments on biodiversity conservation. With regards to the international instruments, the
31 authors argue that both the CBD and Ramsar Convention include urban areas within their scope for
32 conservation. The CBD's COP decisions hold the key for implementation and they recognise the need
33 to implement the CBD at the city level in order to attain to the Aichi Targets. The voluntary Wetland
34 City Accreditation Network under the Ramsar Convention enhances the awareness on urban
35 biodiversity, but it lacks legal rights or obligations. Furthermore, the Ramsar regime lacks technical
36 guidance on urban biodiversity conservation and ecosystem restoration. Overall, most of the
37 implementation relies on non-binding action plans and strategies.
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40 At the regional level the authors note that the Bern Convention's Standing Committee stipulates that
41 urban biodiversity should be addressed within biodiversity strategies and action plans. The EU Birds
42 and Habitats Directives do not exclude the protection or restoration of biodiversity in urban areas,
43 although most implementation in Member States has taken place in rural areas. Furthermore, the
44 EU Green Infrastructure policy compliments on the restoration of urban ecosystems. Although the
45 focus of these regional instruments has so far not been on urban biodiversity, they can play an
46 important role in achieving the global commitments at the regional level, as the instruments
47 discussed have stronger implementation mechanisms and stronger legal obligations than the global
48 ones.
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51 The Aichi Targets are one of the essential pillars when it comes to non-binding documents that
52 relate to urban biodiversity conservation. The targets' implementation and success rely on the
53 national strategies and action plans. An analysis of the national action plans indicates that the
54 majority of the signatory countries do not have much say on urban biodiversity conservation or
55 urban ecosystem restoration. In today's rapidly urbanized world where more than half of the global
56 population lives in cities, action on urban biodiversity is crucial so as to attain to the Aichi Targets as
57 well as to meet the objectives of the international and regional conventions on the protection of
58 biodiversity and ecosystem services.
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1 The importance of urban biodiversity continues to be a priority under the CBD, as is demonstrated in
2 the draft decisions for the next CBD COP meeting in Cancun in December 2016 (CBD, 2016). Both the
3 draft decisions on biodiversity and climate change, and on ecosystem restoration, explicitly address
4 urban areas. Often, the language in those COP decisions is still rather promotional than obligatory
5 (using words like “encouraging” and “promoting”). In spite of their soft language, the decisions are
6 nevertheless at least a political commitment which can be further used at the regional and national
7 level. It is doubtful that additional strong legal obligations will be agreed upon at the international
8 level in the short term. It is feasible and essential however to have more concrete guidance in future
9 COP decisions, such as the short-term action plan on ecosystem restoration, combined with stronger
10 monitoring and feedback mechanisms for national efforts. Thus would the Global Biodiversity
11 Outlook further establish its authority on implementation overview and the international targets’
12 succession would then become more attainable. The authors acknowledge that pure voluntary
13 commitments will not suffice to attain the international biodiversity targets. The role of regional and
14 national instruments, based on the global commitments, can play a crucial role in this regard. Rather
15 than working out new legal instruments at the regional level, existing binding instruments can be
16 used, not only using them for protection of biodiversity in rural areas, but also in urban
17 environments. The potential role of regional instruments such as Bern Convention and EU Directives
18 regarding the protection and restoration of urban biodiversity need to be further explored.
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*Detailed Response to Reviewers

Comment	Response
Reviewer #1: The authors poorly responded to some recommendations such as:	
- "Why is such a convention [the Bern one] a more binding one? Which are the institutional, political, social or even economic elements of context that could explain it? Furthering these issues would consequently enrich the article and especially section 3 and 4".	The general characteristics of the Berne Convention and its strengths have been addressed in other publications. We have included some more references. We have also briefly added some elements explaining the strength of the Berne Convention. It is however beyond the scope of this paper to deal with this in detail, especially since the Berne Convention did not yet extensively deal with urban ecosystem services. Both the Bern Convention and the EU directives are merely given as a regional example, but the overall focus of the article is a global one.
- "An in-depth and comprehensive critical assessment of the 14th and 15th Aichi Targets would be interesting, especially concerning the used indicators and both their relevance and their efficiency". Consequently, section 3 and 4 remain weak concerning the political and institutional elements which could enlighten the debates on the implementation of more binding instruments (in order to enforce highlights 3 and 4).	We have assessed the two targets specifically regarding their relevance to the restoration of urban ecosystems. The political and institutional elements related to overall implementation have been addressed under Section 3.1. Moreover, such elements related to implementation of urban ecosystem restoration are further addressed in detail under Sections 4.1., 4.2., and 4.4. The reason why we did not assess the overall implementation of these targets is because the scope of this paper does not cover the assessment of overall implementation of targets 14 and 15 but rather is specifically related to urban ecosystem services. The paper does not aim to provide such an assessment as this would broaden the scope and cause incoherence with the previous sections as well as the general objective and message of the paper.
Reviewer #2: The authors have taken sufficiently into account the reviewers comments.	

<p>The article was adapted accordingly to reflect the remarks.</p>	
<p>Reviewer #3: Although there is improvement in including legal aspects/analysis within the paper, the edition lacks emphasizing them. The introduction spends most paragraphs on the importance of urban ecosystem services' conservation, which is not particularly covered elsewhere in the paper.</p>	<p>The narrative of the paper is:</p> <ul style="list-style-type: none"> • Why biodiversity and ecosystem services are important, and should be conserved or restored • Why this is only patchily implemented at the moment • What the various levels of legal protection are <p>We do however agree that this narrative is not sufficiently explained in the introduction. We have amended the introduction part accordingly.</p>
<p>Moreover, in terms of legal dimensions that represent most of the paper's content, the introduction only mentions: "The next sections will examine whether international law provides an adequate legal basis to do so". It is important that the introduction actually introduces what is going to be described in the following sections and some general ideas on findings; it should not include relevant information not covered elsewhere in the paper.</p>	<p>We deal with these aspects extensively in the findings section. However, we have given a more detailed outline of the legal part in the introduction (see also comment below).</p>
<p>For instance, the paper's contribution includes the monitoring of AICHI Targets and content on the Ramsar Convention, but that is not at all mentioned in the introduction. This is strange especially because those topics are emphasized in the conclusion.</p>	<p>See response above (and see comment below).</p>
<p>Most of the content of the current introduction (that is quite long) might be added as another section covering the importance of urban ecosystem services' conservation and research efforts as background for the rest of the paper.</p>	<p>We have indeed restructured the paper accordingly and included a more general introduction, mostly explaining the purpose and structure of the paper. A next section deals with the importance of urban ecosystem services (the 'introduction' part in the previous version of the paper).</p>
<p>3. In addition, the use of spaces between words and after punctuation needs revision</p>	<p>Done.</p>