

## Assessment of biophysical and ecological services provided by urban nature-based solutions: a review



### KEY POINTS

- Local climate regulation and recreation are the most commonly assessed ecosystem services in cities.
- Ecosystem service provisioning by urban NBS has mostly been assessed in China, USA and Europe.
- Most studies were conducted in parks and urban forests.
- Climate change was the most frequently mentioned challenge, followed by human health and well-being.

### ABOUT THE PROJECT

NATure-based URban innovATION is a 4-year project involving 14 institutions across Europe in the fields of urban development, geography, innovation studies and economics. We are creating a step-change in how we understand and use nature-based solutions for sustainable urbanisation.





## Reviewing the evidence base

The aim of the review was to synthesize current literature which assessed ecosystem services (ES) provided by urban nature-based solutions (NBS). The focus was on seven ecosystem services (ES) considered particularly relevant in an urban context: local climate regulation, storm water regulation, waste treatment (incl. water purification and soil remediation) air quality regulation, pollination, recreation and aesthetic benefits. The search resulted in 2629 articles in total. Of these, 526 peer-reviewed publications met the following criteria: 1) presence of the ES searched for in terms of ecological indicators, 2) studying green or blue infrastructure, 3) being specific to the urban context, and 4) being either a review, empirical (field experimental study) or modelling study (incl. mapping studies); and were included in the following analysis.

### Increase of publications on NBS and ES

The earliest publication on ES provided by urban NBS as identified in the review is from 1991, reporting on plants in ponds used for cleaning effluents of urban origin. Since 2010, published research on ES provided by urban NBS has increased exponentially (Figure 1).

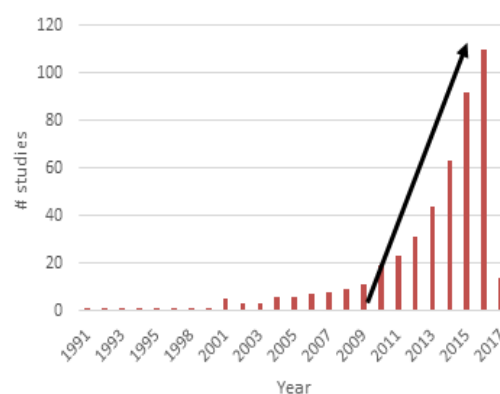


Figure 1: Year of publication of empirical and modelling studies covering ES delivered by urban NBS.

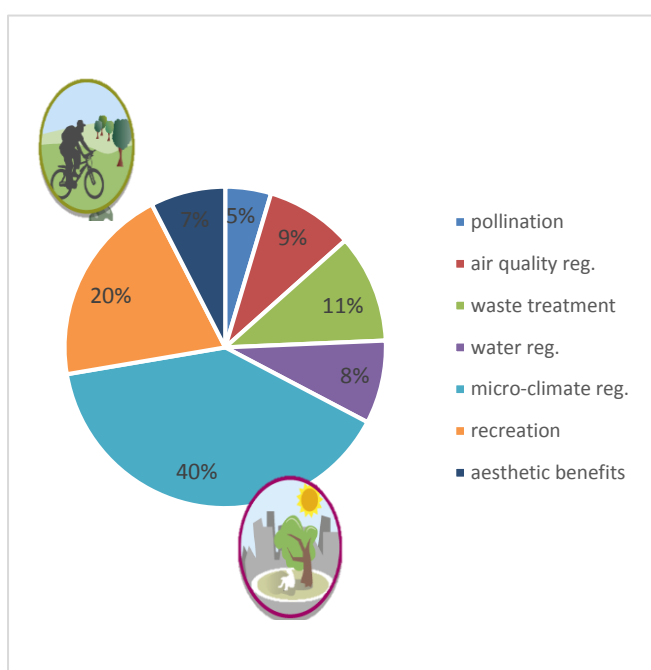


Figure 2: Frequency of ecosystem services assessed in the reviewed publications.

### Majority of studies assess local climate regulation with evidence from around the world

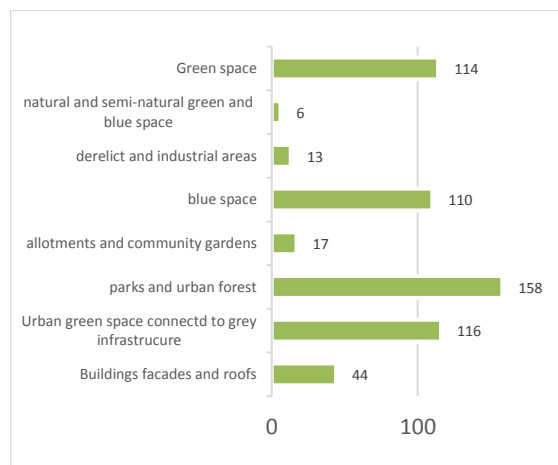
The majority of the studies focused on local climate regulation (40%) and recreation (20%) (Figure 2). The positive contribution of urban green to reduce the so-called urban heat island effect was a common study topic in the identified publications. Pollination, air quality regulation, storm water regulation and aesthetic benefits were less studied (< 10% of the studies each). A low number of studies addressed multiple ES simultaneously. Among those studies, recreation and aesthetic benefits was the most common combination.





### ***Parks and urban forest mostly studied***

'Parks and urban forest' was the most frequently studied ecological domain, covering 27% of the reviewed publications. Other commonly studied domains were 'green space' (22%) and 'urban green space connected to grey infrastructure' (20%). The least studied domains were 'natural and semi-natural green and blue space' (1%), 'derelicts and industrial land' (2%) and 'allotment and community gardens' (3%) (Figure 4). The frequency of ecological domains studied differed depending on the ES. For example, recreation was primarily assessed in 'parks and urban forest' and waste treatment in 'blue space'. Local climate regulation was studied all ecological domains.



*Figure 4: Distribution of ES studies (#) over the different ecological domains*

### ***NBS for climate adaptation, resilience and mitigation***

A wide range of goals was addressed by the publications. 'Climate action for adaptation, resilience and mitigation was the most frequently mentioned goal (32%), especially linked to the service local climate regulation. 'Improving health and well-being' was also a common goal of the publications (24%), which was linked to all ES. Publications on air quality, waste treatment and water management primarily addressed 'environmental quality' challenges, while publications on pollination addressed 'biodiversity conservation'.

### **The knowledge gaps**



We conclude that the evidence base for ecosystem service provisioning by urban NBS is biased towards a few ecosystem services and ecological domains, which highlights the need for 1) studying a wider range of services and ecological domains, and 2) developing quantitative assessment models that can be used not only locally but across ecological domains and locations.