

Preface

The volume *Nature and City. An Integrated Approach to Urban Biodiversity* is published at a pivotal moment for European and international environmental policy. Biodiversity strategies, nature restoration programmes, and the United Nations 2030 Agenda clearly indicate a common direction: ecosystem regeneration, including in urban areas, is no longer optional, but a structural prerequisite for sustainable development.

Global trends underscore the urgency of this transition. Today, more than 55% of the world's population lives in cities, and according to United Nations projections, this figure will approach 70% by 2050. Urban land expansion is occurring at a rate exceeding population growth, leading to soil sealing, habitat fragmentation, altered hydrological cycles, and significant biodiversity loss. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has warned that up to one million species are currently at risk of extinction, while the Intergovernmental Panel on Climate Change (IPCC) estimates that over 3.3 billion people live in highly climate-vulnerable contexts. Within this scenario, cities are simultaneously drivers of ecological degradation and potential laboratories for systemic solutions.

A crucial challenge concerns restoring soil functions within urban environments. Depaving asphalted surfaces, re-establishing ecological connectivity, integrating sustainable drainage systems, and designing neighbourhoods capable of regenerating natural capital rather than consuming it are fundamental actions. Rethinking urban development means creating environments where citizens can rediscover a tangible coexistence with nature, reducing urban heat islands, improving air quality, enhancing stormwater infiltration, and creating habitats for multiple species.

This book addresses this paradigm shift with scientific rigour and design-oriented vision. It proposes an integrated framework for urban biodiversity that transcends the traditional separation between planning, engineering, ecology, and governance. The chapters dedicated to Nature-based Solutions (NbS) and ecosystem restoration demonstrate that urban regeneration cannot be reduced to a set of technical interventions. Instead, it requires participatory processes, shared governance, and long-term ecological strategies. Sustainable regeneration must not merely enhance isolated ecosystem

services; it must restore underlying ecosystem functions, combining an ecocentric perspective with measurable social and economic benefits.

The core message of this volume — the profound interdependence between citizens' well-being and biodiversity — is strongly supported by scientific evidence. Access to green spaces has been associated with reduced cardiovascular disease incidence, improved mental health outcomes, and lower stress levels. Urban green and blue infrastructures can reduce peak temperatures by 2–4°C during extreme heat events, while sustainable drainage systems significantly enhance infiltration capacity and mitigate flood risks. Urban biodiversity should therefore be understood not as an aesthetic addition, but as critical infrastructure supporting public health, water security, climate regulation, air quality improvement, and social cohesion.

This vision is fully aligned with the One Health paradigm, which recognises the intrinsic link between ecosystem health and human health. The National Biodiversity Future Center has embraced this approach as a strategic pillar of its mission, promoting research that integrates natural sciences, engineering disciplines, social sciences, and technological innovation.

The volume is embedded within the activities of the NBFC, established under Italy's National Recovery and Resilience Plan (PNRR) – NextGenerationEU. In particular, it aligns with the research dedicated to urban biodiversity, aimed at the multilevel characterisation of ecological dynamics in cities and the development of effective and resilient Nature-based Solutions. The attention given to applied instruments, such as the NbS CataTool, reflects the commitment to translating advanced research into operational tools for public administrations, planners, and decision-makers.

Urban planning plays a decisive role in this transformation. Urban Nature Plans — currently voluntary in many contexts but increasingly central to funding frameworks and regulatory evolution — represent a paradigm shift from fragmented interventions to integrated, long-term strategies grounded in scientific evidence and continuous monitoring. This issue is even more critical in emerging countries, where rapid urbanisation often occurs in the absence of robust regulatory frameworks. In such contexts, integrating biodiversity into planning processes is essential to prevent environmental degradation, resource conflicts, climate vulnerability, and irreversible natural capital loss.

The strength of this work lies in its genuinely multidisciplinary approach. Architecture, civil and environmental engineering, ecology, circular economy, governance, and public engagement converge within a coherent framework in which biodiversity becomes a structuring principle of urban design.

Through multidisciplinary research such as that developed within the NBFC, it is possible to generate Evidence-based Solutions to support urban biodiversity while simultaneously identifying technological innovations that enhance the design, implementation, monitoring, and long-term management of interventions. Advanced environmental monitoring networks, high-resolution ecological data integration, remote sensing applications, digital twins for urban ecosystems, predictive climate-risk modelling, and ecosystem service performance indicators represent enabling tools for scaling up Nature-based Solutions in a measurable and replicable manner.

Embedding biodiversity within urban systems requires robust metrics, adaptive governance frameworks, and longitudinal assessment of ecological and socio-economic outcomes. Nature-based Solutions must therefore be evaluated not only in terms of immediate co-benefits, but also in relation to ecosystem functionality, resilience thresholds, and long-term maintenance requirements. Integrating ecological science with engineering design and data-driven decision support systems is essential to ensure

that urban regeneration strategies deliver quantifiable improvements in ecosystem integrity and human well-being.

In this perspective, biodiversity becomes a structural variable in urban development models, a determinant of climate adaptation capacity, public health resilience, and sustainable resource management. The transition toward biodiversity-positive cities depends on the ability to align scientific knowledge, technological innovation, and planning instruments within coherent, evidence-based frameworks.

Only by strengthening this science–policy–practice interface can urban systems evolve toward models that are ecologically functional, socially inclusive, and resilient under accelerating environmental change.

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