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## Empowering urban wellbeing and biodiversity through design-driven citymaking

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**Abstract:** This paper presents a practice-based account of the roles that design can play in the realization of a biodiversity-driven approach to citymaking, specifically as part of urban regeneration. The authors first retrace the evolving relationship between design and citymaking in light of contemporary urban regeneration challenges, to identify the potential roles design can play in these contexts. Urban biodiversity is then explored as a factor relevant to urban well-being, ecosystem services, and proactive citizenship, clustering the types of actions that can support a biodiversity-sensitive urban regeneration. Following these premises, a portfolio of initiatives centered on urban biodiversity within a large-scale urban regeneration project in Milan (Italy) is presented to exemplify how design-led interventions can favor the urban natural environment. From these insights, the authors reflect on how designers can work with urban biodiversity to drive sustainable practices while re-establishing people's relationship with nature and empowering communities' participation in urban transformation.

**Keywords:** urban regeneration, urban biodiversity, design-driven citymaking, urban well-being



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## 1. Introduction

Today's relationship between design and city-making<sup>1</sup> should be considered by firstly looking back at the past decades-long academic debate on what the fundamental constituents of the "city" and how designers should intervene on them.

As Graus reports (2021) by referencing Richard Sennett, we can think about the "city" as emerging from "the accumulation of fine-grain human places that people value as an experience, that evolve slowly over time, tinkered with and adapted from the bottom up at the local level"; or, conversely, as " [...] comprehensively planned" by top down planning and policies (Graus, 2021, pp. 394-395).

The consolidation of the former vision of "city" was followed by an evolution of design that increasingly confronted with a scale of intervention it did not traditionally deal with (Deserti, 2016). Similar changes are also reflected in traditional city-making disciplines; as could be noted by urban design expanding through the concept of urbanism (Inam, 2014); and planning theory critically reflecting on its modernist roots through the idea of "insurgent planning" (Campagnari, 2023).

The importance recognized to city branding, placemaking, urban services and communities was key to these evolutions; as well as the consolidation of soft policy instruments to drive urban regeneration initiatives (Bell & Jayne, 2003).

By recognizing this background, this paper intends to advance knowledge on design for city-making by describing the realization of a design-driven approach for urban regeneration centered on urban biodiversity. Our goal is to identify the different roles design can play for strengthening biodiversity-centered urban transformations.

## 2. Design's roles in city-making

Design for city-making discussion dates back at least to the early 70s (Allen & Queen, 2018; Echaniz et al., 2022) where it mostly concerned the application of participatory design principles to urban planning (Cross, 1971, p. 12). This discourse evolved after place-making affirmation in urban design and planning. By expanding the notion of city-making as only concerned with designing the physical dimension of the urban environment (i.e., buildings, infrastructures), place-making advances that design urban spaces require facilitating and fostering cities' intangible elements, such as individual experiences and relations (Graus, 2021). Design approach and competencies are hence relevant for city-making today since they may support placemaking in creating social life in public spaces (Sedini et al., 2023), as well as acting upon other intangible factors that shape cities (e.g., service systems, branding, productive activities) (Deserti, 2016).

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<sup>1</sup> With "design" we refer to the disciplinary and cultural field usually developed in higher education institutions through design curricula. "City-making" (Landry, 2012) is used as a short-hand to refer to the design and realization of city transformations according to the contemporary paradigm.

In our earlier review (Foglieni et al., 2023) we identified three perspectives (Design for Territories, Design for Social Innovation, and Design for Policy) that should be considered to comprehensively advance a new role for design in city-making. By building on them, we propose three roles for designers:

**Designer as materializer (of places)**

Traditional design competencies related to artifact production (products, prints, media, interiors) appear relevant, especially for city branding. Designers can support in materializing otherwise intangible places' assets (Deserti, 2016), also by fostering a "design culture" that reads into urban social-material systems (e.g. manufacturing) and valorizes them as part of urban development strategies (Julier, 2016). Local authorities experimented design-led urban regeneration to mix urban spaces' structural interventions with communication, branding, and events (Bell & Jayne, 2003).

**Designer as facilitator (of communities' participation)**

Design for social innovation posited collaborative services as central for sustainable and socially inclusive urban development (Baek et al., 2015). However, these instances appear in crisis today, since leaving urban transformation to third sector/civil society self-organized activities appears to absolve institutions from their responsibilities and reinforce a neoliberal vision (Bragaglia & Caruso, 2020). To counter that scenario, urban decision-makers may support these stakeholders' actions, thus fostering their agency in cities' transformations (Selloni & Manzini, 2016). Designers can support that intent and, through co-design, facilitate access to communities' local knowledge (Arthur & Sopjani, 2022), build empathy (De Costa et al., 2022), understand needs and cultures (Echaniz et al., 2022), visualize informal network of activities (Davoli et al., 2014). In this role, the designer uses artifacts as mediating tools for critical framing (Allen & Queen, 2018), also working with urban futures (Pollastri et al., 2016) to mediate a top-down vision of city development, as the technology-driven "smart city" (Ferronato & Ruecker, 2018; Geenen et al., 2022; Mullagh et al., 2022).

**Designer as mediator (of urban policies)**

Design for city-making can unfold through local governments embodying design practices, competencies, and strategies (Hyysalo et al., 2022; Kim et al., 2022; Mullagh et al., 2022; Starostka et al., 2022). At this level, design's role can be both operational and strategic (Kim et al., 2022), contributing to services, light interventions in the built environment, participatory activities, organizational development, training, communication, and strategy-making (Hyysalo et al., 2022). It is suggested that design's role at the local policy level is not only instrumental but political as, through design, decision-makers may attempt to challenge and mediate power relations (Starostka et al., 2022).

In this discourse, urban nature, appears still largely untouched. There seems to be space for proposing that designers start to work with awareness regarding urban biodiversity; for example by including it in material urban design solutions (Edwards et al., 2022) or in public

engagement activities (Crosby & Vanni, 2023). This proposal may appear even more relevant as urban biodiversity is increasingly regarded as an essential factor to well-being, ecosystem services, and proactive citizenship, and it is becoming widely supported at policy level. In the next section we explore actions in favor of urban biodiversity as potential contexts for the application of the design roles described above.

### 3. Biodiversity-centered actions for urban transformation

Biodiversity is an essential asset for maintaining the resilience of ecological systems (IPBES, 2019) and, consequently, for the future well-being and development of human societies (Folke et al., 2016).

Today, about 25% of species are threatened globally; this generates a severe risk to food security (IPBES, 2019), climate change mitigation, the supply of energy resources and the status of ecosystem services (ES), i.e. the direct and indirect contributions of ecosystems to the survival and well-being of humans and non-humans.

Following the overview on the roles design can play in city-making, we focus here on the challenges of cities concerning the loss of biodiversity and related ES, to then reflect on how design can intervene to enact the "transformative change" necessary to make the role of nature more evident in cities (Das Neves, 2020).

To such an extent, we conducted another literature search (including policy directions) aimed at exploring the role of biodiversity in urban environments, and more specifically in urban regeneration, and we integrated it with the analysis of urban projects explicitly considering or addressing biodiversity issues. This investigation allowed us to cluster different kinds of actions that are typically introduced at urban level in favor of the natural environment, and that we named advocacy, connection and agency actions.

In the next sections they are presented as results of our research.

#### 3.1 Human and biodiversity well-being in urban environments

Despite limited green space, cities are the habitat for more than 45,000 species, including many native species, some typical of surrounding areas, others that reside only in the city (Sattler et al., 2011).

Nevertheless, it is crucial nowadays to implement strategies to conserve biodiversity, restore habitats that bring native and target species back to the city (Obrist et al., 2013), and raise awareness to improve people's affective and experiential connection with nature (Mayer and Frantz, 2004) in order to care for it and halt its decline.

Many studies show that environmental awareness (intended as the predisposition to learn about nature, care for it, and act to conserve it) mainly relies on formative experiences in direct contact with nature (cfr. e.g. Chawla, 1998; Cheng et al., 2021). Mayer and Frantz (2004), through their *Connectedness to Nature Scale* (CNS), argue that by measuring the affective and experiential connection of adults with nature, it is possible to predict

environmental behaviors. Accordingly, experiences and targeted information about the ecological value of green urban environments could help find the support of people to conservation in terms of individual behaviors, collective actions, and positions as decision-makers (Dunn et al., 2006). Other studies, then, investigate the benefits of green spaces on the health and well-being of citizens living in urban centers (e.g. Thomson, 2002). For example, research conducted within the project "*BiodiverCity*" of the Swiss National Research Program (Obrist et al., 2013) shows that for almost all interviewees (96%), access to green areas is considered necessary for quality of life and proximity to green spaces influences residential choices.

These studies suggest that direct experience with nature, combined with personal values, social and cultural variables, and the level of awareness, can determine an individual's involvement in nature protection actions. Consequently, we can argue that biodiversity "advocacy actions" must be geared toward creating the necessary awareness and knowledge to enable such behaviors.

These actions can vary in scale and scope and range from environmental education projects in schools to supranational projects focusing on improving knowledge for different kinds of actors, as in the case of the proGireg project<sup>2</sup>. A Massive Open Online Course (MOOC) called "Nature-Based Urban Regeneration" was created to educate decision-makers on co-creating Nature-Based Solutions (NBS)<sup>3</sup> with local communities, measuring their environmental, economic, and social benefits. With the same intention, a digital catalog of NBS was published on the URBiNAT project platform<sup>4</sup>, which citizens can co-select and co-create based on their needs, aspirations, and local environmental conditions.

From a health perspective, biodiverse places are deemed particularly effective in improving psychological well-being, reducing both physical and mental stress, generating positive emotions, and facilitating the renewal of cognitive resources, thus classifying themselves as "*restorative environments*" (Bellini et al, 2015; Hartig, 2004).

Moreover, there seems to be a positive correlation between psychological well-being and the perception of biodiversity in urban areas: results from the *BiodiverCity* project (Obrist et al., 2013) show that spaces, where a high variety of flora and fauna is present, meet the ideal expectations of both citizens and biodiversity.

This correlation further emphasizes the importance of actions that not only raise citizens' awareness and knowledge but also foster a direct connection with nature. In the next section, we will discuss how regeneration contexts, guided by national and international policies, represent the ideal context for activating these kinds of actions.

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<sup>2</sup> [progireg.eu/the-project/](http://progireg.eu/the-project/)

<sup>3</sup> Nature-based solutions are actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges (Fifth session of the United Nations Environment Assembly, UNEA-5, 2022).

<sup>4</sup> [urbinat.eu](http://urbinat.eu)

### 3.2 Biodiversity protection through urban regeneration

The urgency to preserve biodiversity, together with the need to bring back nature into cities while establishing a reciprocal benefit for the citizens and the environment, has not only led to the emergence of “advocacy actions” as those mentioned above. Cities are hotspots where opportunities and sandboxes for experimentation are concentrated, and urban regeneration projects often represent the ideal occasions for such experiments.

International and national bodies are developing policies related to urban biodiversity: the Kunming-Montreal Global Biodiversity Framework (UN, 2022) guides the implementation of actions to bring about a transformation in our relationship with biodiversity by 2030. The framework supports local biodiversity policies that encourage sustainable usage and fair sharing of its benefits. It also emphasizes awareness and education in local communities to preserve biodiversity.

Along the same lines, the European Commission with the New Biodiversity Strategy 2030 (EC, 2020) called on cities of at least 20,000 inhabitants to develop ambitious urban greening plans, including accessible and biodiversity-rich forests, parks and gardens, green roofs and wall, to help improve connections between green spaces and inhibit practices harmful to biodiversity.

Some cities are experimenting with these green placemaking strategies (Gulsrud et al., 2018), especially within regeneration action. One example is provided by the project of the Natural Park of Lama Balice in Bari, Italy (Tarsitano et al., 2021), where biodiversity has been restored through cultural and social interventions (sensory labyrinth, vegetable gardens and natural architectures) that aspire to increase the citizens’ quality of life while respecting the principles of sustainability and social participation. The same applies to the *Tempelhofer Feld Initiative*<sup>5</sup>, a former airport area in Berlin (Germany) now devoted to biodiversity recreation and protection. The city has also implemented a maintenance plan for the area, which includes cooperation with citizens.

According to our interpretation, these can be considered examples of “connection actions” between humans and biodiversity that are necessary to the abovementioned direct connection with nature and are functional to “advocacy actions”. Exploring policies and practices centered on urban biodiversity, another kind of action can lastly be detected. Starting from EU strategies, the Italian Ministry of Ecological Transition has drawn up an operational document, the National Biodiversity Strategy 2030 (Italian Government, 2023), where the actions suggested for halting biodiversity loss in urban green areas go beyond the integration of ecosystem management plans among urban plans and tools, and the creation of green infrastructures. They include citizen participation in both the implementation of small strategies to support biodiversity within private spaces, and the promotion of participatory practices for data collection and monitoring of urban green spaces, especially through citizen science and educational programs.

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<sup>5</sup> [www.thf100.de](http://www.thf100.de)

Citizen science activities, i.e. the collection and analysis of data by citizens in collaboration with professional scientists, are deemed to significantly contribute to the UN Sustainable Development Goals (Fraisl et al., 2020), particularly about indicators related to monitoring biodiversity and endangered species. These actions require citizens to play an active role in biodiversity preservation and can thus be called “agency actions”. For example, *BirdLife International*<sup>6</sup> has established a network of volunteer observers collecting data on bird populations, and it uses data from citizen science projects, such as eBird<sup>7</sup>, to compile a list of threatened bird species.

To sum up, analyzing how cities are dealing with the urgent matter of preserving urban biodiversity for the benefit of the planet and people's well-being, three kinds of actions can be detected ("advocacy," "connection," and "agency") that, in addition to NBS, are becoming central in urban transformation. In the next sections, we reflect on how these actions can combine with the different roles design can enact in city-making to make nature a protagonist of urban transformation. We do so by illustrating some design interventions realized in the context of T-Factor<sup>8</sup>, a project funded under the Horizon 2020 framework for European research, from June 2020 to June 2024.

## **4. An example of design-driven citymaking for urban biodiversity: the T-Factor project at MIND - Milano Innovation District**

### *4.1 T-Factor project overview*

T-Factor aims to demonstrate the transformative potential of temporary uses as part of urban regeneration initiatives across six pilot projects in Europe, and as critical assets for the city to establish more inclusive and sustainable regeneration processes.

In this paper, we refer in particular to the experiments held in Milan, Italy, at MIND - Milano Innovation District. MIND is the first innovation district dedicated to life sciences in Italy, and it is located on the site of EXPO2015. The regeneration process of this area started in 2017 and will be completed in 2031.

The experimentation on temporary uses proposed by T-Factor at MIND was carried out by a group of partners<sup>9</sup>, members of the so-called Local Coalition. But before delving deeper into the interventions, it is worth mentioning the design-driven process followed by all T-Factor pilots to envision and then prototype temporary uses on-site. In fact, the process was made of four steps, called “design stations”, inspired by the four phases of the design process (i.e. discover, define, develop, deliver) illustrated by the Double Diamond (Design Council, 2007).

This process was conceived and guided by the so-called Transformation Agency (T-Agency), i.e. a group of project partners in charge of methodologically supporting the six pilots and

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<sup>6</sup> birdlife.org

<sup>7</sup> ebird.org

<sup>8</sup> t-factor.eu

<sup>9</sup> Polifactory - Department of Design of Politecnico di Milano in Milan, LAND Italia Srl and PlusValue Italy Srl.



their Local Coalitions. The T-Agency was composed for the most part of the design research groups of three major design universities in Europe whose role was to inform the pilots' development with a number of design-driven methods and tools spanning design thinking, service design, systemic design, and design for policy.

#### *4.2 Design interventions for urban biodiversity at MIND*

Following the process proposed by T-Factor, the milanese Local Coalition firstly worked at exploring the local context to be addressed by temporary uses, through listening and co-creation sessions with stakeholders and potential beneficiaries of the area, facilitated by the T-Agency. At MIND, three missions were identified under the overarching challenge of building a new identity of the area based on nature, health and well-being. For the sake of this paper, we will exclusively report on the interventions answering to the only mission aligned with the topics discussed here, i.e. that of promoting well-being through green practices and open air activities, to make MIND a site of reference for more conscious, healthy, and sustainable lifestyles. To achieve this mission, following what emerged from participatory sessions, and aware of the benefits for human wellbeing deriving from the connection with nature (Obrist et al., 2013; Thomson, 2002), the Local Coalition decided to experiment with temporary uses that explore the link between people and biodiversity in urban spaces.

These interventions were ideated, coordinated and implemented by the authors of this paper, belonging to a design research group of the Department of Design of Politecnico di Milano and composed by product, communication, service, and policy designers. The main intervention consisted of the design and implementation of a temporary garden-laboratory, called **Herbula Wild Garden**, open to both the internal and external communities of the district, and aimed at educating people to the benefits of urban biodiversity.

While the overall layout and set-up of the garden were designed by the landscape architects of the Local Coalition, with the support of the design team, most of the seeding and planting activities were co-produced with different groups of beneficiaries of the garden.

Herbula was composed of three different areas (Fig. 1):

- an area with planters, dedicated to the cultivation of aromatic and officinal herbs available to those interested in using them for culinary or herbal preparations;
- an experimental area, dedicated to educational research and botanical or agronomic experiments, especially devoted to the cultivation of edible native species that can be processed and transformed into everyday products;
- a flowery meadow, dedicated to spontaneous vegetation capable of attracting pollinators and other useful insects.

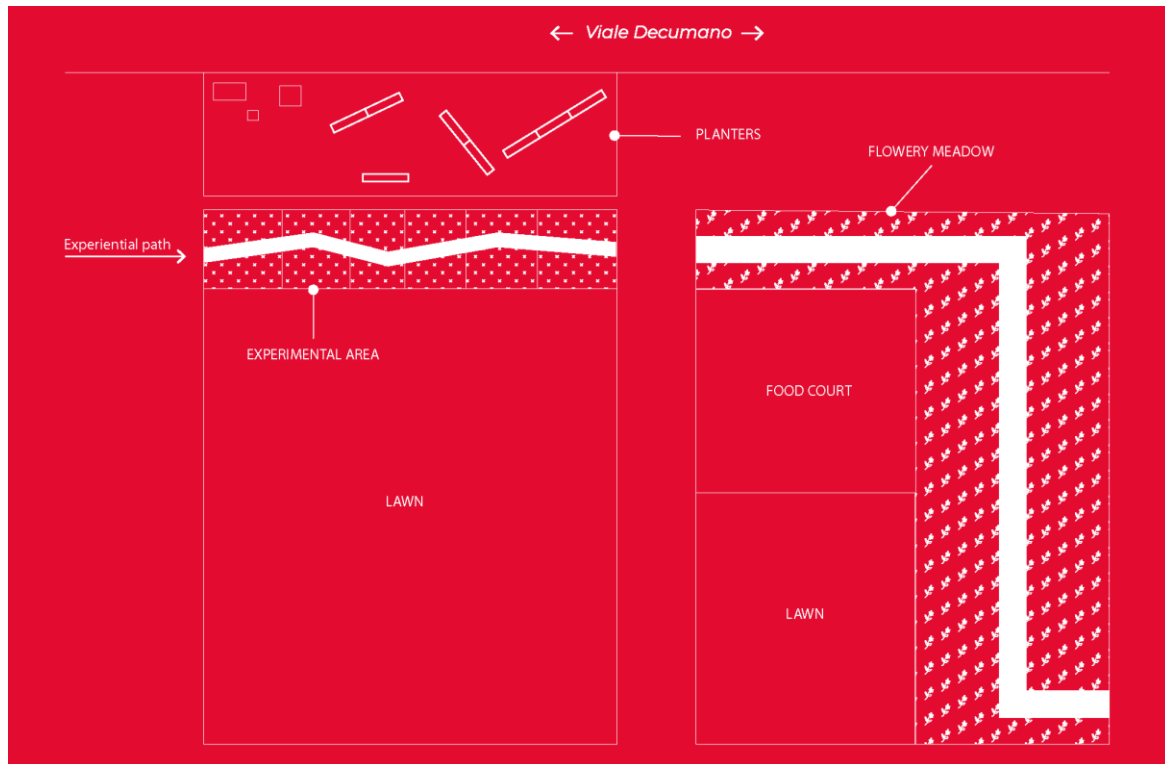


Figure 1 Map of Herbula Wild Garden

The differentiation between these areas allowed the development and realization of different kinds of initiatives around the topic of urban biodiversity, which are shortly listed as follows and described in more detail in Appendix 1:

**BiodiverCity@MIND for Schools**, an environmental education activity centered on the direct experience of biodiversity, dedicated to primary and secondary school students;

**Herbula Lab**, an experimental co-creation laboratory with high school design to design and set up a resilient garden made up of wild edible plants;

**Civic Nature Exhibition**, an open-air experiential path through the different areas of the Herbula Wild Garden, aimed at spreading awareness on how to interact with urban biodiversity;

**Biodiversity Ambassador Program**, a citizen science activity dedicated to people working inside the district, aimed at collaboratively mapping the animal species present in the area.

#### *4.3 Reflections on the role of design in between urban biodiversity and citymaking*

The initial analysis of the role of design in citymaking and the exploration of actions cities are undertaking (or should undertake) in support of urban biodiversity give us the interpretation keys for reflecting on the design interventions realized at MIND.

In the table below, the different interventions are positioned, for what concerns the role of design, according to the interpretation of the authors who led the design and implementation process; and for what concerns the type of action, according to the intentions expressed by the Local Coalition, which are reported as follows.

*Table 1 Interpretation of design interventions for urban biodiversity.*

	Advocacy actions	Connection actions	Agency actions
Design as materializer	Civic Nature Exhibition	Herbula Wild Garden Civic Nature Exhibition	BiodiverCity@MIND for Schools Civic Nature Exhibition
Design as facilitator	BiodiverCity@MIND for Schools Herbula Lab	BiodiverCity@MIND for Schools	Herbula Lab Biodiversity Ambassador Program
Design as mediator	Biodiversity Ambassador Program		

Starting from the most traditional role of design as materializer, the Herbula Wild Garden represents a clear example of spatial design, although temporary, centered around the connection with urban biodiversity, since it was born as a place aimed at making people immerse into nature for the sake of enjoying it, while stimulating curiosity, learning, and eventually interaction. This was further emphasized by the installation of the Civic Nature Exhibition, which required the contribution of spatial, product and communication design competencies, whose purpose was not only to create a pleasant experiential path, but also to raise awareness and knowledge about urban biodiversity through informative panels (advocacy action), and to stimulate action by asking for contribution to biodiversity mapping (agency action).

The role of design as materializer is also exemplified by the BiodiverCity@MIND for Schools initiative, referring in particular to the role of product design in creating physical props (i.e. the bug hotels, see Appendix 1) that encourage people in interacting with nature and actively support it (agency action).

The BiodiverCity@MIND for Schools initiative sheds light on another role design can play in favour of urban biodiversity, i.e. the facilitation of processes and activities aimed at designing advocacy and connection actions. In fact, in order to set-up the initiative, which is clearly configured as an advocacy action, it was necessary to identify and engage several local stakeholders, including natural science experts, and guide them in building the educational process to be proposed to students, according to MIND characteristics and missions.

Designers played a facilitation role also in guiding the on-field phase of the process, during which, thanks to guided tours and experiential workshops, they enabled the direct connection of students with nature.

Similarly, the Herbula Lab initiative represents an example of advocacy action facilitated by design, since designers organized and runned several activities with students aimed at co-designing the experimental area of the garden. Since such activities later turned into the real implementation of the experimental area by the students themselves, and contents created by the students were then channelled through the Civic Nature Exhibition, to push people in approaching these kinds of practices, we can consider Herbula Lab an example of agency action facilitated by design too.

Another example of agency action facilitated by design is provided by the Biodiversity Ambassador Program, whose main purpose was to engage MIND employees in participatory biodiversity mapping activities. Designers role here was to guide employees in the use of the technology chosen for mapping and in the execution of the tasks envisaged by the program. In this case, design also played the important role of mediator with the companies by structuring and proposing an initiative with the intention to advocate for the inclusion of biodiversity into the organizations' welfare policies and, in general, bringing the topic to the attention of company leaders.

We did not have the chance to explicitly explore and experiment the role of design as mediator of connection and agency actions at MIND. Nonetheless, the way the Herbula Wild Garden was designed, and the initiatives it was able to host created tangible evidence for both MIND decision-makers and local policy-makers about the importance of creating spaces in cities to connect with local biodiversity, and about how these kind of experimentations can become the testbed for the development of new local programs and policies in favor of urban biodiversity.

Overall, we can affirm that in terms of advocacy and connection the actions implemented obtained positive results, demonstrated by the fact that schools required to replicate the activities with other classes during the following school year. The teachers involved, interviewed at the end of the activities, stated that the possibility to be on field and contribute to the building of the space through practical activities mediated by props was crucial for engagement and for successfully conveying the message. Especially considering that, in this area of the city, direct contact with nature is scarce, and the topic is usually treated inside the school spaces. Also, they considered the participatory approach adopted and the design of specific props fundamental to go beyond the traditional playful approach adopted in these kinds of activities, making them more formative and professional. These considerations confirm the potentialities of design as materializer and facilitator of advocacy and connection actions in support of urban biodiversity, at least for a scholastic audience.

The Civic Nature Exhibition, conversely, highlighted some major constraints for the role of design as materializer that might be taken into consideration. First, the need to continuously activate the community addressed. In fact, the Exhibition obtained positive interactions only

during specifically designed events<sup>10</sup>, while in other periods, people present in the district did not explore it, despite being positioned close to the only food facility of the area. Second, the maintenance of the designed artifacts over time when envisioned for a wild natural space. In fact, unforeseen climate events and the uncontrolled growth of wild plants can easily compromise what has been carefully designed and reduce the effectiveness of both the messages and the functions (and thus the advocacy and agency actions) defined in the beginning.

Similarly, despite the Biodiversity Ambassador Program was positively perceived by companies it was proposed to, and people who decided to participate declared to be enthusiasts of an extra-work activity during which they get in contact with nature while actively contributing to biodiversity mapping, participation was lower than expected. Half of the people who initially manifested their interest never conducted the activities envisioned by the program, raising doubts once again the limits of design (alone) when it comes to agency actions.

To conclude, thanks to the experience provided by the T-Factor project at MIND, we can infer another important role design could play in citymaking in general, and in favor of urban biodiversity in particular, which is not explicitly emerging from the literature analyzed. We refer to the role designers played in T-Factor in defining the methodological approach to be followed by all pilot projects; and in supporting the Local Coalition in firstly envisioning and then implementing a “system” of temporary uses centered on urban biodiversity. We call it “system” because all the interventions were designed in connection with each other, as part of a comprehensive strategic plan headed toward a common objective. Within this system, the role of designers was multifaceted. Besides materializing, facilitating and mediating as reported above, they were in charge of mentoring the Local Coalition from a methodological point of view, defining the strategy of implementation of temporary uses in response to pilot missions, and, as a consequence, planning activities, timing and resources. In this sense, the designer could be considered the “orchestrator” of biodiversity-centered actions, recalling some service and strategic design literature (e.g. Patricio and Fisk, 2013; Windahl et al. 2020).

Linking to this orchestration role, a final reflection can be done about the need to involve extra disciplinary competencies in the design of urban biodiversity actions, to make design interventions not to produce controversial effects for the well-being of both people and the environment. In the case of MIND, these competencies were provided by landscape architects, natural science experts, agronomists, foragers and food processing experts. It is only through the collaboration with specialized expertise that designers’ actions, being they advocacy, connection or agency actions, can aspire to bring concrete benefits to biodiversity-centered citymaking.

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<sup>10</sup> Detected through the access to the digital contents linked to the informative panels of the Exhibition.

## 5. Conclusion

Although the benefits of nature connectedness on citizen's well-being, at both physical and psychological level, have been proved by several studies, and the urgency of fostering human actions that encourage the flourishing of biodiversity into cities is nowadays increasingly addressed by global policies, we cannot ignore that current city-making still treats unequally human and non-human elements of the ecosystem. Conversely, to advance sustainability and resilience agendas in urban contexts requires rethinking urban green areas to maximize biodiversity conservation and human well-being at the same time.

From a brief literature analysis, in this article we firstly retrace the contribution of design to city-making over time, which ranges from the "material" design of spaces (and related artifacts), to the facilitation of communities' participation, to the mediation for the design of urban policies and strategies.

Similarly, looking at literature, but also through an overview of some relevant policies and practices, we identify three categories of actions that, in addition to NBS, are often suggested for the creation of a stronger bond between people and nature or can be easily recognized in urban regeneration projects that give high priority to biodiversity protection. They entail: advocacy actions for increasing biodiversity awareness and knowledge; connection actions for improving quality of life through the direct link with nature; and agency actions, for making people actively act in caring for the environment.

A design-driven urban regeneration project in Milan, which realized a portfolio of initiatives centered on urban biodiversity, is described and analyzed to exemplify how designers can enact their multiple roles in the different kinds of biodiversity-centered actions. What emerges is that, while the role of design as materializer and facilitator of advocacy and connection actions seems to bring positive outcomes, its agency capacities appear less effective because of constraints brought by the nature of the community involved and the unpredictability of the natural environment. Similarly, the role of design as mediator depends on the direct involvement of decision-makers and policymakers, who often require extra-design capacities. To conclude, an open reflection about the contribution design can bring as an orchestrator of a biodiversity-centered urban transformation is argued, but in synergy with other extra disciplinary competencies necessary to expand current design-driven approaches to urban regeneration.

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## APPENDIX 1: Description of design interventions at MIND related to urban biodiversity

### 1. BiodiverCity@MIND for Schools



Figure 2 BiodiverCity@MIND for Schools' activity. Students assembling bug hotels.

This environmental education activity was dedicated to students from local primary and secondary schools and was configured by the design team in collaboration with landscape architects and a local association of natural science experts. It involved students in a three-phase process:

*Learning about biodiversity*, a 2-hours activity in class, during which natural science experts introduced the topic of urban biodiversity;

*Experiencing biodiversity*, a 4-hours on field activity at MIND, during which students were accompanied by natural science experts in a biodiversity tour of the area across four different green environments. After the tour, the students were involved in a workshop led by the design team and the landscape architects at the Herbula flowery meadow. The workshop consisted of assembling bug hotels specifically designed and produced by the design team through digital manufacturing technologies, and composing seed bombs aimed at seeding the flowery meadow itself (Fig. 2);

*Envisioning biodiversity*, a 2-hours activity in class, during which students were asked to reflect on their experience at MIND, expressing their personal vision on how to foster biodiversity in the area through the creation of dioramas.

## 2. Herbula Lab



Figure 3 Herbula Lab. Students working in the experimental area.

This activity involved students of an agrarian high school in Milan in the design and set-up of the experimental area of the Herbula Wild Garden. In agreement with the teachers of the school, it was decided to create a resilient wild garden, made up of edible native plants, suitable for transformation into everyday products, for gastronomic, cosmetic or herbal purposes.

After a presentation and a first site inspection, the design team conducted a workshop in class with the purpose of supporting the students in selecting the species to compose their resilient garden, through botany cards and recipe templates. These contents were then digitized and published in the digital herbarium<sup>11</sup> and cookbook<sup>12</sup> of the Herbula Wild Garden. Students were later provided with the seeds of the selected species, which were brought to germination in the school greenhouse. When the plants were grown enough to be transferred into the soil, the students went to MIND to finally plant the selected species into the experimental area (Fig. 3).

As a concluding step, a practical activity was organized at school to show the students how to transform the plants (through processes such as distillation, fermentation and dehydration), in collaboration with one expert from a local laboratory for research and experimentation on the use of wild plants for human nutrition.

## 3. Civic Nature Exhibition

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<sup>11</sup> [mind.t-factor.eu/herbula-wild-garden-herbarium](http://mind.t-factor.eu/herbula-wild-garden-herbarium)

<sup>12</sup> [mind.t-factor.eu/herbula-cookbook](http://mind.t-factor.eu/herbula-cookbook)



Figure 4 Civic Nature Exhibition

The work done with students culminated in an open-air exhibition, called Civic Nature. The exhibition consisted of an experiential path through the different areas of Herbula, where visitors could find several information panels and boards, developed by the design team, aimed at spreading awareness on urban biodiversity and how to interact with it (Fig. 4). These were giving information on herbs and wildflowers visible in the garden, and were linked through QR codes to further digital contents. Online content also included a series of videos recorded through photo-traps (disseminated in the area in the previous months), to make people know the animals that live in the city<sup>13</sup>. Moreover, throughout the path, people were invited to action by contributing to biodiversity mapping on the iNaturalist app, following the simple instructions reported on the panels.

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<sup>13</sup> [mind.t-factor.eu/herbula-wild-garden-bestiarium-2](http://mind.t-factor.eu/herbula-wild-garden-bestiarium-2)

#### 4. Biodiversity Ambassador Program



Figure 5 Biodiversity Ambassador Program

To further engage the internal community of the district, the design team, in collaboration with landscape architects, ideated an activity dedicated to companies, to make them start to consider biodiversity in their sustainability reports and include biodiversity-related activities in their welfare system. A selection of companies was presented with the possibility to take part in the Biodiversity Ambassador Program, which entailed an open call to employees to run simple biodiversity mapping tasks useful to detect the fauna present in the district. Employees who decided to become Ambassadors were invited to a training moment where they were guided in using the iNaturalist app (Fig. 5), and those who managed to report at least 5 observations within a given period were granted a small reward.