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PERSPECTIVE

When honeybees come to town: Critical aspects of urban beekeeping and opportunities for regulation

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Abstract

1. Urban areas are increasingly valued for their role in conserving wild pollinators. Honeybees are often regarded as ambassador species for pollinator conservation, and beekeeping is frequently perceived as a pro-biodiversity activity, which has become highly popular in urban areas. However, the rapid increase in documented urban honeybee populations raises concerns about potential competition for resources and disease spillover into wild bee populations. This calls for better regulation and management of urban beekeeping.
2. Drawing on previous studies, we present and discuss six critical social-ecological aspects of urban beekeeping, specifically, (1) the rapid growth of urban beekeeping, (2) asymmetries in the distribution of honeybee hives across beekeepers, (3) disrupted thermal balances, (4) knowledge and perceptions on urban floral resources, (5) competition for floral resources and (6) health management and disease transmission. We then discuss pathways towards a social-ecological regulation of urban beekeeping.
3. We advocate developing an urban bee management concept as a tool for establishing contextualized and equitable policies that work across urban land-use gradients. Such a concept can support the management of urban landscapes for mixed uses, including biodiversity conservation and agricultural production, including beekeeping. However, this concept must emerge from co-design and co-creation processes involving all stakeholders, including beekeepers and conservationists, thereby integrating diverse views and preventing confrontation. In doing so, cities can better design, manage, and plan their landscapes to support all pollinators.

KEYWORDS

Apis mellifera, asymmetries, beekeeping association, cities, policy-making, thermal ecology, wild bees

1 | INTRODUCTION

Cities are a significant driver of changes in biodiversity and ecological communities while simultaneously holding potential for conservation. This is especially true for wild bees and other non-bee pollinators (Baldock, 2020). The discourse surrounding bee declines has coincided with a rise in urban beekeeping. Particularly, the increase in urban beekeeping is driven in part by a general perception that the Western honeybee (*Apis mellifera*, Linnaeus, 1758) is under threat, associated with a 'save the bees' narrative (Alton & Ratnieks, 2016; Egerer & Kowarik, 2020; Geldmann & González-Varo, 2018). Moreover, honeybees are often perceived as an ambassador species for insect pollinator conservation. Hence, beekeeping is also regarded as a pro-biodiversity activity and has become very popular in urban areas (Egerer & Kowarik, 2020; Sponsler & Bratman, 2021); this has made honeybees an ubiquitous insect in cities worldwide (Casanelles-Abella et al., 2025; Matsuzawa & Kohsaka, 2021). Furthermore, urban areas have been less exposed to pesticides and can, in some cases, support greater phenological diversity and floral resource availability compared to intensified agricultural areas (Park et al., 2023; Sexton et al., 2023; Zaninotto et al., 2023). All of these factors have been combined with a lack of regulations on urban beekeeping, which has further facilitated its popularity and increased the number of beekeepers (Lorenz & Stark, 2015; Matsuzawa & Kohsaka, 2021, 2022). However, if urban floral resources are insufficient to support these increases in honeybee numbers, the increase in urban beekeeping activity could lead to food shortages for honeybees and other flower-visiting insects such as wild bees, creating an unsustainable situation for both managed honeybees and wild pollinators (MacInnis et al., 2023; Requier et al., 2024; Sponsler & Bratman, 2021). Resource disparity has already been reported in London, UK, by the London Beekeepers' Association (LBKA, 2020) and in scientific research (Stevenson et al., 2020).

A lack of suitable forage can negatively impact both honeybees and wild bees, due to increases in intra- and interspecific competition for floral resources, which has been reported in urban (MacInnis et al., 2023; MacKell et al., 2023; Renner et al., 2021; Ropars et al., 2019) and non-urban (e.g. agricultural) areas (Page & Williams, 2023a; Steffan-Dewenter & Tscharntke, 2000; Thomson, 2004; Wignall et al., 2020). Furthermore, competition for floral resources can be exacerbated in urban areas where honeybees are non-native or even invasive (Garibaldi et al., 2021; Russo et al., 2021; Thomson, 2004). Increasing honeybee population numbers may also lead to increased disease transmission (Sponsler & Bratman, 2021). Overall, these concerns have sparked discussions on how urban beekeeping can be balanced with the conservation of wild bees and non-bee pollinators in cities through improved policies and regulatory frameworks (Egerer & Kowarik, 2020; Johannsen et al., 2021; LBKA, 2020; Mouillard-Lample et al., 2023). In this perspective paper, we provide a brief background on urban beekeeping and beekeeping's known and hypothesized effects on wild bees, discuss critical social-ecological aspects of urban beekeeping and explore the potential solutions and regulatory tools for promoting the coexistence of honeybees with wild bees in cities. We aim to emphasize the understudied complexity of this social-ecological system.

2 | URBAN WILD BEE DIVERSITY

Urban areas can harbour a large diversity of wild bee species (Casanelles-Abella, Chauvier, et al., 2021; Fauviau et al., 2024; Fournier et al., 2020; Liang et al., 2023). This is due, in part, to enhanced resource availability (e.g. through gardening and wild bee habitat planning in urban green spaces), reduced exposure to pesticides, and the availability of specific nesting substrates, such as cavities (Baldock, 2020). Certain urban habitats can be hotspots for wild bees, for example, the different types of urban gardens present in the landscape (e.g. home gardens, allotments, botanical gardens, Baldock et al., 2015, 2019; Silva et al., 2023). The diverse bee faunas found in cities suggest that urban areas can be important ecosystems for conserving wild bees (Baldock, 2020; Turo et al., 2021), although the role of species of conservation concern is limited (Fauviau et al., 2024; Liang et al., 2023). This is relevant because the last international agreements (e.g. Kunming-Montreal Global Biodiversity Framework; CBD, 2022) have emphasized integrating cities and urban habitats in biodiversity conservation efforts. Besides their value in preserving biodiversity, wild bee species contribute to the reproduction of spontaneous and cultivated plants and thus provide important ecosystem functions and services (Blareau et al., 2023; Liang et al., 2023; Lowenstein et al., 2015).

3 | URBAN HONEYBEES

The ecology and behaviour of honeybees differ from those of wild bees. Honeybees are generalist species, live in colonies with very large numbers of workers, distribute tasks among workers, have enhanced sensory systems and complex communication that enable them to navigate through complex landscapes, scout large areas to find resources, learn how to exploit them and communicate the location to the rest of the colony (Hammer & Menzel, 1995; Klein et al., 2019; Lindauer et al., 1999; Strube-Bloss & Rössler, 2018). These life history characteristics of honeybees mean they might be less sensitive to the presence or absence of certain plant species, less vulnerable to pollen toxicity and able to meet nutrient requirements more easily than wild bees. Finally, honeybee genetic and phenotypic diversity has been altered through selective breeding and hybridisation to generate more productive and resource-depleting breeds. In conclusion, honeybees can better cope with challenging and novel environments, such as urban ecosystems, and potentially consume more resources than wild bees.

4 | BEEKEEPING ACTORS AND BEEKEEPING PRACTICES IN CITIES

Urban beekeeping diverges from traditional beekeeping practices in non-urban systems, particularly regarding the urban beekeeping actors, including individuals, collectives and companies that own and often, but not always, manage beehives. Studies investigating the diversity of urban beekeeping actors and their characteristics are still largely missing, but defining characteristics include their motivations, the number of hives per beekeeping actor, expertise and their total numbers (DiDonato & Gareau, 2022; Egerer & Kowarik, 2020; Johannsen et al., 2021). While there is no official categorization of urban beekeeping actors, we distinguish five groups: individual hobbyists, collectives (e.g. educational institutions, community gardens), commercial ventures, corporate beekeeping and turnkey beekeeping companies.

The first two groups, namely individual beekeepers and collectives, are often motivated not only, or not necessarily, by economic gain, but also by other reasons, such as leisure and a willingness to perform perceived pro-environmental actions (Figure 1; DiDonato & Gareau, 2022; Egerer & Kowarik, 2020). These two groups, particularly hobbyists, represent the majority of beekeeping actors, often owning few hives and varying levels of training (Lorenz & Stark, 2015; Sponsler & Bratman, 2021). A lack of training and subsequent involvement in beekeeping associations is concerning (Connolly, 2019) because it may lead to failure to adhere to proper practices, which, for example, can negatively affect hive health. The second group comprises the commercial ventures, which are highly trained beekeepers that often keep many hives for profit (e.g. honey, propolis, wax and other products) within urban areas, as is traditionally done in non-urban ecosystems. It is worth noting that urban honey production brings branding and economic opportunities (Lopéz-Galán & de-Magistris, 2025; Quiralte et al., 2023), particularly given higher market honey prices and consumer preferences for local or regional products (Bissinger & Herrmann, 2021).

'Beewashing' (sensu Colla, 2022; MacIvor & Packer, 2015) by some corporate organizations (i.e. corporate beekeeping) involves another group of beekeeping actors. Beewashing superficially proposes to support environmental efforts and their Environmental, Sustainability, and Governance (ESG) targets through highly visible actions with limited environmental benefit (Matteucci, 2022; Mawardii, 2023; Weston, 2021). Furthermore, honey production and branding by corporate beekeeping can also contribute to corporate identity and represent public engagement (Lopéz-Galán & de-Magistris, 2025). The number of beehives these organizations keep can be much higher than those managed by individual beekeepers (Mawardii, 2023, Figure 1). Interacting with the different beekeeping actors are the so-called turnkey beekeeping companies that rent one or more hives to their clients (e.g. companies, schools) and offer experienced beekeeping services. These beekeeping companies typically do not focus on large-scale honey production; instead, they generate profits from their beekeeping services, averaging 500–3000 euros per hive (Mawardii, 2023). While the number of hives per client is often small, turnkey companies can have multiple clients in a city. Differences in the number of hives and motivations of urban beekeeping actors can result in tensions among them, for example, over unequal use of common floral resources or disease prevention strategies (Sponsler & Bratman, 2021).

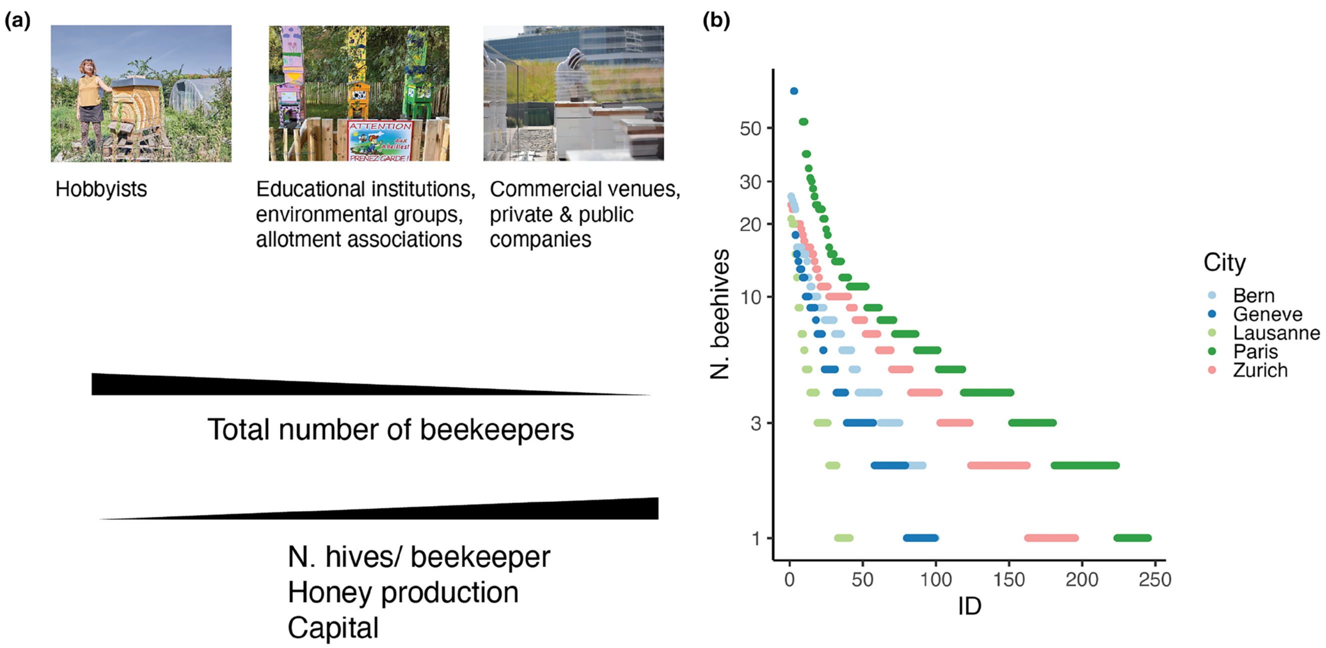

FIGURE 1 Urban beekeepers. (a) Examples of urban beekeeping actors according to their total numbers and the expected number of hives per beekeeper, total honey production and capital. (b) Five examples of the distribution of urban beehives among beekeepers (beekeeping actors). Number of hives per beekeeper in one French (Paris, data from the Ministry of Agriculture and Food Sovereignty) and four Swiss (Bern, Geneve, Lausanne and Zurich, data from the cantonal veterinary offices) cities. The *x*-axis (ID) represents a registered beekeeping actor. The *y*-axis shows the number of hives (spacing is log-transformed) per registered beekeeping permit. See Text S1 for additional information on the data. Photo credit: Silke Meyer salzundhonig, Bienenstand im Peace of Land, Saskia Uppenkamp; Vancoucerconvention in flickr CC BY-NC-SA 2.0.

Urban beekeeping practices can range from minimal intervention (e.g. little honey harvesting) to intensive management involving supplemental feeding. Different beekeeping practices may have differential impacts on urban ecosystems and on honeybees' nutritional demands, thereby affecting honeybee interactions with wild bee species and other non-bee pollinators. The diversity of beekeeping actors, lack of awareness of other beekeeping actors already present in an area and the lack of specific legislation for urban beekeeping can create complex situations and are likely to contribute to large beehive densities observed in cities (e.g. Casanelles-Abella & Moretti, 2022; MacInnis et al., 2023; Ropars et al., 2019). For instance, even though individual hobbyists typically own few hives, their large numbers within a city landscape might also result in landscapes with large beehive densities, often with hobbyists unaware of the surrounding densities.

5 | CRITICAL SOCIAL-ECOLOGICAL ASPECTS

5.1 | Rapid growth of urban beekeeping and honeybee populations

Over the last two decades, urban beekeeping has increased in cities across several continents (Figure 2). Consequently, the number of hives, beekeeping actors, and the densities of hives have increased (Casanelles-Abella & Moretti, 2022; Figure 2; see also Stevenson et al., 2020). The growth in hive numbers indicates an increasingly large, urban, managed honeybee population across multiple cities. For example, in Zurich, Switzerland, the number of hives increased from 898 in 2014 to 1233 in 2023 (Figure 2). In Berlin, Germany, the number of hives registered increased from <2500 in 2005 to >7500 in 2022 (Figure 2). MacInnis et al. (2023) reported an increase in the total number of hives in Toronto from 238 to almost 3000 hives from 2013 to 2020. Moreover, available data on a turnkey urban beekeeping company also showed an increase in the number of beehives between 2017 and 2022 (Young et al., 2024). Specifically, from 163 to 391 hives in Montréal, and from 54 to 394 hives in Toronto (Young et al., 2024). Consequently, honeybees have become widespread and abundant in multiple cities, often accounting for a large proportion of the bee individuals captured in urban bee studies (e.g. Casanelles-Abella et al., 2025; MacInnis et al., 2023). Overall, honeybees are present well beyond their natural distributional ranges, including many cities outside Europe, Africa and West Asia. Thus, this implies urban honeybees are non-native and often considered invasive in several cities where beekeeping is currently practised (MacInnis et al., 2023).

5.2 | Asymmetries in the distribution of urban beekeeping

While data are still scarce (few cities have information on the distribution of beehives among beekeeping actors), and when availablility

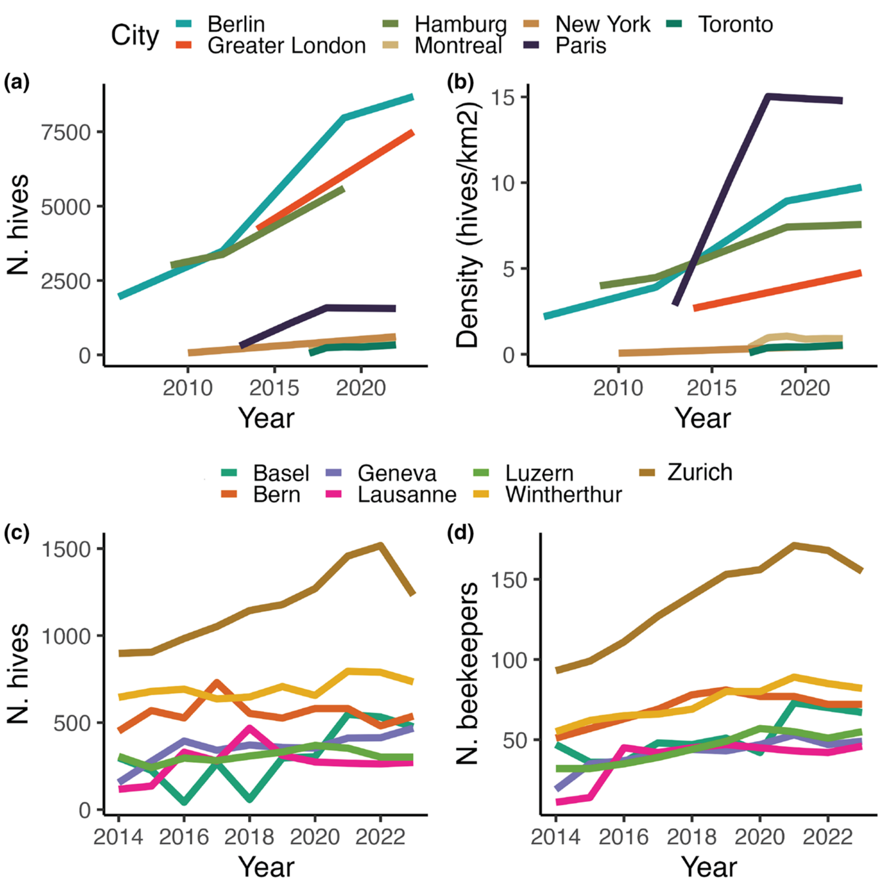

FIGURE 2 Examples of the growth patterns of urban beekeeping. (a, b) Number of hives and hive density in five cities from Europe (Berlin, Paris, Hamburg and London) and three cities from North America (New York, Toronto and Montreal) between 2005 and 2022. (C, D) Number of hives and number of beekeepers in five Swiss cities for the period 2014–2023. See Text S2 for additional information.

is often difficult to obtain (e.g. not openly available, not shareable, language barriers), the existing beehive census data we obtained (Figure 1, Text S2) show asymmetries in the distribution of beehives, with many beekeepers having one or few hives and a small number of beekeepers having large numbers of hives (Figure 1). This seems to be the case of the Swiss cities of Zurich, Bern, Lausanne and Geneva (Figure 1) and the French city of Paris (Figure 1). The situation in other cities remains unknown due to a lack of data. It is worth noting that beekeepers with high numbers might not keep all their hives in a single location but distribute them across the city. Furthermore, the asymmetries in the distribution of beehives could be a consequence of some specific groups of beekeeping actors, such as corporate beekeeping (in Paris, Matteucci, 2022; in London, Mawardii, 2023; see also Segal, 2023). How widespread this pattern is across cities worldwide remains unknown, but it deserves further attention.

From a social-ecological perspective, the asymmetry in the distribution of hives has important consequences for urban beekeepers. First, it suggests that bees managed by a few actors may exploit a larger proportion of the existing floral resources than most beekeeping actors with one or a few hives, with consequences for resource consumption and potential competition between honeybees and wild bees. It also highlights the vulnerability of urban ecosystems to decisions by specific actors, who, in the absence of regulations, may substantially alter the demand, production and consumption of floral resources (Sponsler et al., 2023). Consequently, ecological processes such as competitive interactions and bee population dynamics are affected. Second, it might counteract actions of some beekeeping actors, possibly individual hobbyists and collectives that own and manage honeybees themselves (e.g. for educational or recreational purposes), who might be reducing their hive densities (e.g. by sharing hives, Turner, 2021) and increasing floral resources often in coordination with local urban beekeeping associations.

5.3 | Disrupted thermal balances

Keeping honeybees in artificial hives increases their food requirements (Jarimi et al., 2020). The natural nesting conditions of honeybees, specifically the hive's thermal balance, are disrupted with the use of artificial hives (e.g. Langstroth hives) due to insulation problems and the need for hive inspections and honeybee harvests (Jarimi et al., 2020). In feral populations (i.e. in their natural state), honeybees maintain a constant hive temperature by nesting in well-insulated sites, typically in a tree with narrow, thick-walled cavities lined with propolis (Mitchell, 2016). In contrast, artificial hives are poorly insulated, forcing honeybees to buffer temperature fluctuations by increasing their energy investment, which, in turn, increases food requirements (Jarimi et al., 2020). Moreover, honey harvesting also increases the food demands of colonies. Harvesting of honeybee products may additionally occur at a time of year when there are few available floral resources, especially when beekeepers are beginners without adequate training. In cities, artificial hives can be subject to higher temperature stress than in other environments, as they are more likely to be placed on impervious surfaces (e.g. rooftops and backyards; Figure 3) within

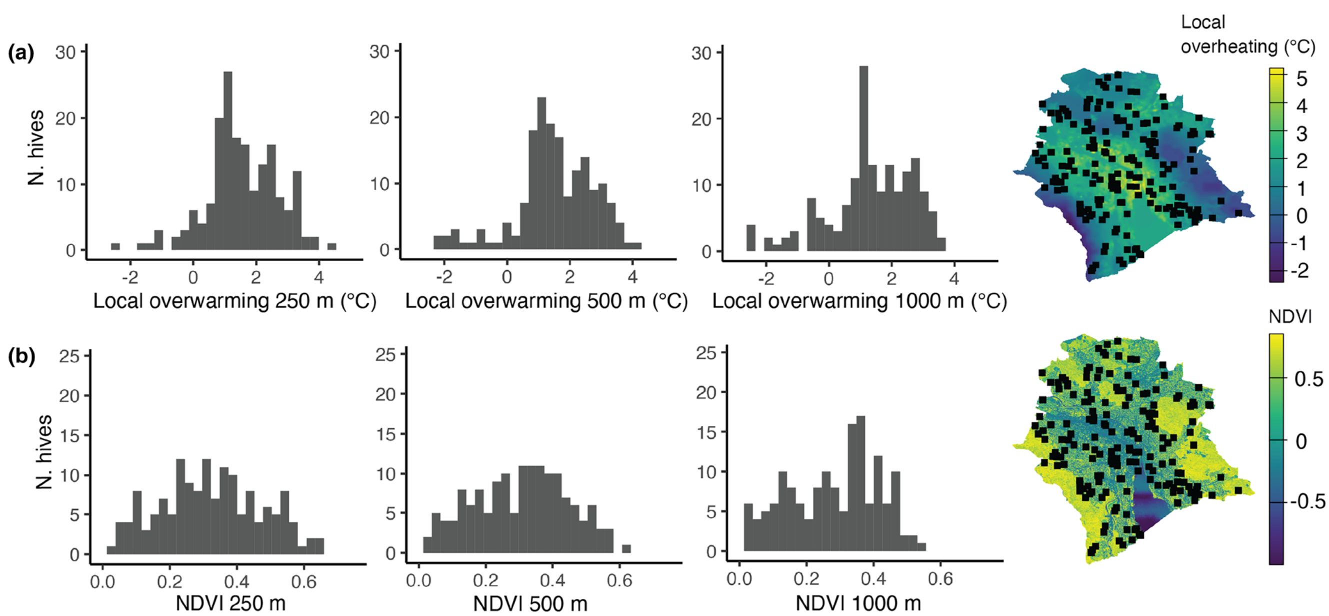

FIGURE 3 Distribution of beehives in Zurich along local overheating and greenspace availability. (a) Histograms of the mean overwarming surrounding beehives in Zurich at three spatial buffers (250, 500 and 1000 m). The map depicts the modelled overheating in the city of Zurich from 2009 (Parlow et al., 2010) and the distribution of beehives (represented by black dots) in 2018. Overheating measures the increased heat load of air temperature (above the ambient temperature) due to heat exchange with urban surfaces (Parlow et al., 2010). Negative temperatures indicate temperatures below the baseline temperature. (b) Histograms of the mean value of the normalized difference vegetation index (NDVI) from 2018 surrounding beehives in Zurich at three spatial buffers (250, 500 and 1000 m). The map depicts the modelled NDVI in the city of Zurich and the distribution of beehives in 2018.

densely built landscapes. Increased temperature stress also results in higher energetic costs to maintain hive temperatures, thus increasing the food requirements of the hives, which likely reduces honeybee welfare and increases stress levels (Garrido & Nanetti, 2019). Higher city temperatures, due to the urban heat island effect and climate change, may further exacerbate these processes.

5.4 | Knowledge and perceptions on urban floral resources

The availability of urban floral resources, including nectar and pollen, along with their nutritional value (Parreño et al., 2022), is a critical factor determining whether and to what extent wild bee, as well as non-bee pollinators, and honeybees can coexist. However, the availability of urban floral resources is largely unknown to beekeeping actors, managers and stakeholders. Urban plant diversity patterns are highly variable among and within urban green space types, for example, due to differences in management, preferences, uses and legacies (Avolio et al., 2021; Johnson et al., 2015; Swan et al., 2017). Furthermore, urban floral resources are temporally heterogeneous (Kreider et al., 2020; Stevenson et al., 2020). Therefore, urban areas have high spatio-temporal heterogeneity in the floral resource availability (Baldock et al., 2019; Tew et al., 2021, 2022).

Thus, the perception of floral resource availability by stakeholders, managers or users (e.g. beekeeping actors) is limited at best and may be skewed, biased, and therefore incorrect. They might even be inaccurate or overly optimistic, potentially resulting in management decisions and behaviours that do not reflect the ecological reality of floral resources. In addition, floral resource assessments often rely on indirect estimates like plant diversity (Baldock et al., 2019; Casanelles-Abella, Frey, et al., 2021) or the amount of green cover due to the lack of data on actual nectar and pollen production and their nutritional values, which are the key factors linking plants and pollinators. Consequently, the availability of floral resources is often incomplete. As honeybees can roam freely across the cityscape and access most habitat patches, beekeepers may have the wrong impression that urban ecosystems have a surplus of floral resources, perhaps even while floral resources are being depleted. Overall, the incomplete or biased perception of urban floral resources, as well as honeybees' consumption rates of these resources, may reduce awareness of the need to increase available forage and to adapt beehive densities accordingly, with important consequences.

Finally, this implies that the carrying capacities of bees (and insect pollinators generally) in urban ecosystems are also unknown. Urban floral resources, particularly plant production rates (Sponsler et al., 2023), are among the primary components determining bee carrying capacities in cities. Specifically, bee carrying capacity estimates the maximum number of wild and managed honeybees that can be maintained within a given area and during a specific period. Similar to floral resources, bee carrying capacities are expected to be highly dynamic in space and time and are currently unknown to beekeeping actors, managers, and stakeholders. On the other hand, the perceptions of urban floral resources, combined with a large number of actors, can result in the placement of hives in landscapes with low resource availability (Figure 3; see also Young et al., 2024) or in areas with already existing high hive densities, thereby accentuating mismatches with existing resources. This can be accentuated by existing constraints imposed by authorities, registration requirements or incentives, which may further limit the placement and selection of inadequate locations.

5.5 | Competition for floral resources

Insufficient resources to meet the needs of both wild bee and honeybee populations can lead to increased competition for floral resources. Competition for floral resources has been better and mostly documented in non-urban ecosystems (reviewed in Iwasaki & Hogendoorn, 2022; but see also the review from Pike & Rittschof, 2025), but existing evidence indicates it is also occurring in some urban ecosystems (Prendergast & Ollerton, 2021; Renner et al., 2021). Competition for floral resources can displace wild bees, particularly specialist species or those with significant niche overlap (Elliott et al., 2021; Lázaro et al., 2021), ultimately altering their diet preferences and nutritional intake (Page et al., 2024). Nutritional intake influences bee health (Parreño et al., 2022), and thus altered nutrition might eventually shape individual bee fitness (Parreño et al., 2022; Vaudo et al., 2015, 2024), scaling up to population- and community-level responses (Vaudo et al., 2018, 2024). Finally, there are still several uncertainties and inconsistencies regarding floral resource competition that requires more research (Pike & Rittschof, 2025), including the fact that 'competition need not be constant or even frequent to be influential, since one lean year in ten might be sufficient to drive local extinctions that would persist unless reversed by immigration' (Sponsler & Bratman, 2021). Thus, as the number of honeybee hives and individual honeybees increases, there may be unknown short- to long-lasting impacts on wild bee and non-bee pollinator communities in urban habitats.

5.6 | Health management and disease transmission

Honeybees are affected by bacterial, viral, and fungal diseases (Evans & Schwarz, 2011; Piché-Mongeon & Guzman-Novoa, 2024). Increasing evidence points out that diseases traditionally associated with honeybees can be transmitted to other insects (e.g. Maurer et al., 2024), particularly wild bees (Fürst et al., 2014; Graystock et al., 2016). While the topic warrants further research, disease transmission from honeybees to other wild bee species is likely influenced by beehive densities (Sponsler & Bratman, 2021). Furthermore, it can be accentuated when beehive health management differs among beekeeping actors and when beehive densities are higher. Differences in honeybee health management can be highly variable due to differences in training and expertise among beekeeping actors, which can even result in conflicts between beekeeping actors (Sponsler & Bratman, 2021).

6 | ECOLOGICAL CONSEQUENCES OF AN ASYMMETRIC, OPEN-ACCESS SITUATION

The trends in urban beekeeping resemble other dilemmas of shared open-access resources with few to no regulations (Ostrom, 2008). Specifically, an unregulated increase of urban hives and beekeeping actors without accounting for the common yet finite or declining available floral resources (e.g. due to urban densification, urban sprawl, changes in planting preferences). This can have adverse effects on wild bees due to increased competition for floral resources (Balfour et al., 2015; Mouillard-Lample et al., 2023; Wignall et al., 2020), which may be further aggravated when honeybees are non-native (Page & Williams, 2023b). Moreover, resource scarcity can enhance intra-specific competition among honeybee colonies (Sponsler & Bratman, 2021). Finally, the asymmetries in the distribution of hives among beekeepers in cities (Figure 2) may further indicate an unequal distribution of resources. In this case, a few large-scale or well-established beekeeping actors with numerous hives may utilize most of the available urban space and common floral resources, leaving fewer resources for small-scale beekeeping actors with fewer hives.

7 | OPPORTUNITIES FOR SOCIAL-ECOLOGICAL REGULATION

Urban beekeeping calls for social-ecological regulation appropriate to its urban context. Restrictions, policies or controls that consider the origin status of honeybees, hive densities, asymmetries in the distribution of beehives, the different motivations of beekeeping actors, wild bee communities and their diversity, as well as other non-bee pollinators, environmental stressors on honeybees and information on existing floral resources are largely absent (Matsuzawa & Kohsaka, 2021, 2022). In this final section, we discuss the opportunities for social-ecological regulation, adapting the recommendations from Beaurepaire et al. (2025) for agricultural landscapes to the urban context (Figure 4) and following the principles outlined by Ostrom (2008). Specifically, we propose developing an 'urban bee concept' in cities to establish contextualized and equitable policies that work across urban land-use gradients and harness co-design processes involving all stakeholders, including urban beekeeping actors and conservationists. The urban bee concept should include 'reasonable and beneficent norms for urban beekeeping' (Sponsler & Bratman, 2021), but also aid decision-makers to determine what parts of the city are fully devoted to wild bee conservation and what parts can have mixed use, that is, with a certain intensity of urban beekeeping. Such an urban bee concept is composed of three main components (Figure 4): (1) the social-ecological criteria to contextualize regulation; (2) the mitigation measures and associated implementation tools that are co-designed with stakeholders and are situated within the social-ecological context; and (3) the implementation of mitigation measures, which also integrates re-evaluation and adaptation processes based on successes and failures.

7.1 | Social-ecological context

From an ecological perspective, we propose four points: first, the origin status and invasive potential of honeybees. Regulations may need to be stricter in cities outside honeybees' natural distribution ranges to prevent potential invasions and increased displacement (Page & Williams, 2023b). Second, the availability of resources and the degree of niche partitioning. Here, specific habitats may enable honeybees and wild bees to partition available resources more effectively. For instance, the phenologies of honeybees and wild bee species might not temporally overlap, or when they do, the structure of floral resources can prevent niche overlap (Casanelle-Abella et al., 2025). Third, the shared diseases and disease spillover risk. The final point concerns the distribution of environmental stressors, such as temperature and pollution, which influence honeybee health (Jarimi et al., 2020) and wild bee diversity (Geppert et al., 2022). While these topics should form the ecological basis, it is essential to note that there are still main research gaps (several summarized in Beaurepaire et al., 2025), for example, on obtaining meaningful estimations of carrying capacities in urban areas based on the nutritional needs of bees (Casanelles-Abella et al., 2023; Stange et al., 2017). From a social perspective, given the predicted asymmetries in the number of beekeeping actors, the composition and configuration of urban beekeeping actors, as well as their numbers of hives and distribution, are critical pieces of information for fostering equitable policies.

7.2 | Mitigation measures

We propose four measures to enhance co-existence between honeybees and wild bees and minimize negative impacts (Figure 1). The selection and implementation of a given mitigation measure depends on the social-ecological context. First, the reduction of beekeeping actors and/or hives in areas deemed to have excessive beekeeping intensity, such as in Oslo, Norway (Stange et al., 2017). Second, the ban of urban beekeeping in certain areas, for example, following bee conservation criteria (Henry & Rodet, 2018; Lanner et al., 2025) or based on overall honeybee welfare to avoid exposure to stressors such as pollution or overheating. Such an approach is being implemented in some cities, including Zurich, Switzerland (Stadt Zürich, 2025), and Berlin, Germany (Senatsverwaltung für Umwelt, Verkehr und Klimaschutz, 2019; Stange et al., 2017), yet not considering different beekeeping actors. Third, enhancing floral resources. Fourth, developing bee health management plans to enhance disease prevention, detection and treatment. There are available solutions to implement such measures. For example, sharing honeybee hives can effectively reduce beekeeping intensity

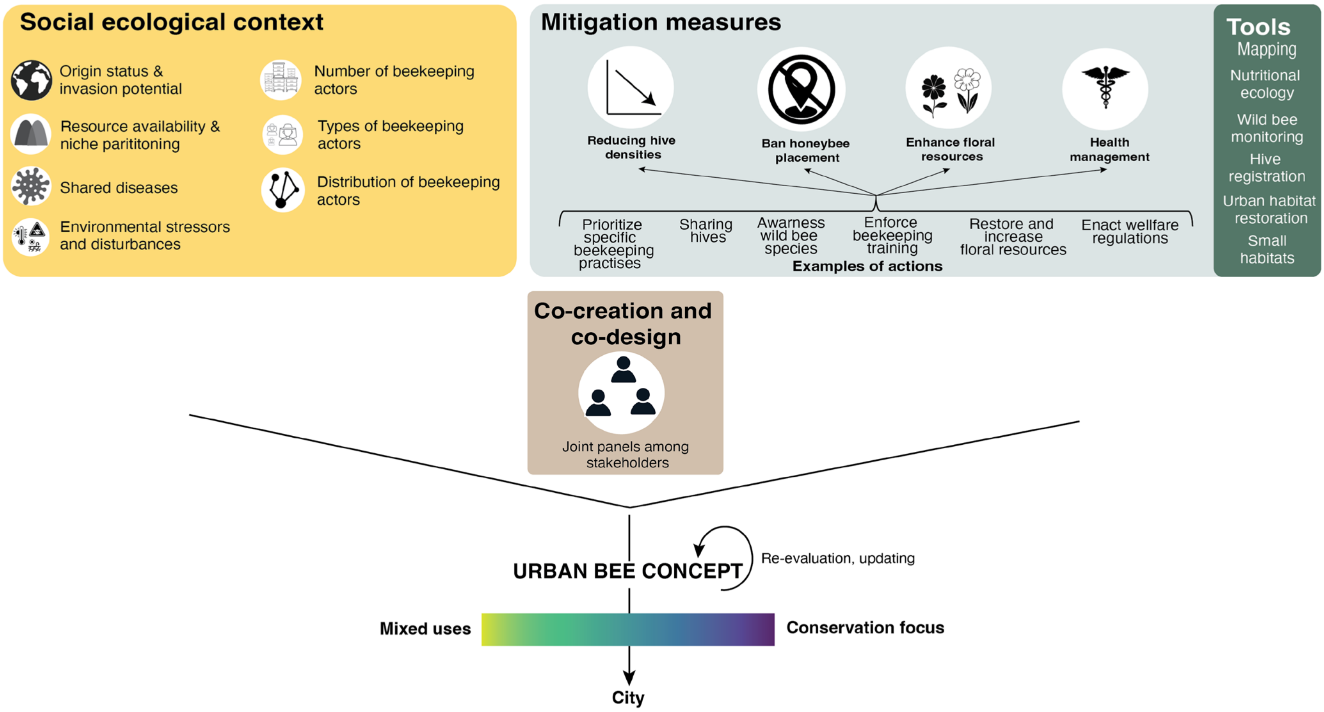

FIGURE 4 The urban bee concept. Through the integration of social-ecological knowledge and context and through the development of mitigation strategies, a coexistence concept for both managed and wild bees can be co-created among involved stakeholders (e.g. beekeepers, conservationists, government officials). Such an urban bee concept is city-specific and results in a specific priorization of the urban landscape for both conservation and mixed uses. The figure is inspired and adapted by the works of Beaurepaire et al. (2025), Sponsler and Bratman (2021) and Egerer and Kowarik (2020) and our discussions with the governmental office *Bienenfachstelle des Kantons Zürich*, the beekeeping association *Zürcher BienenFreunde* and the London Beekeepers' Association LBKA.

while avoiding the exclusion of certain beekeeping actors, such as hobby beekeepers. Targeted measures to specific beekeeping actors (e.g. corporate beekeeping, Mawardii, 2023) could reduce existing asymmetries in the exploitation of floral resources by increasing hive densities. Furthermore, enforcing adequate beekeeping training, for instance, through courses and mentoring within urban beekeeping associations could improve disease prevention and increase awareness of the negative impacts of overheating and pollution on honeybees, thus improving the selection of beekeeping locations. Similarly, documentation and education on wild bees and their plant hosts represent a critical measure to enhance floral resources and guarantee human–nature interactions.

We see several available tools to help implement and improve mitigation measures (Figure 1, discussed in Text S1). First, the use of mapping tools for the physical environment (temperature, pollution) and floral resources (e.g. Baldock et al., 2019; Tew et al., 2021). Examples of mapping approaches include those by the Agency of the Urban Environment of the city of Oslo, Norway, to delimit '*precautionary areas*' where hive placement is strictly regulated (Stange et al., 2017). Second, performing bee hive registration and monitoring programmes, including the number of hives, health, beekeeping actors and disease status. Third, conducting monitoring of the diversity and distribution of urban wild bee communities. Fourth, documenting and uncovering the nutritional value of the existing plants and wild bee demands (Parreño et al., 2022). Fifth, promoting the restoration (sensu Klaus & Kiehl, 2021) of urban habitats. Finally, managing small urban green spaces to increase habitat availability (Casanelles Abella & Egerer, 2026; Egerer et al., 2024).

7.3 | Co-creation and co-design

Co-creation and co-design of solutions among diverse actors (e.g. beekeepers, conservationists, government officials) who may hold different and sometimes conflicting views is a promising approach to finding reconciliatory and inclusive solutions (Beaurepaire et al., 2025). Similarly, different beekeeping actors may hold distinct and opposing views, particularly when their motivations differ and when asymmetries in hive ownership exist. For urban beekeeping, promoting joint working panels would enable different stakeholders to share their views, receive relevant information on the social-ecological context and available mitigation measures (e.g. which plants could be planted to meet bees' nutritional requirements), and then collaborate to develop the urban bee concept. One potential challenge is ensuring that discussions are not disproportionately influenced by large beekeeping actors and their interests, as maintaining a balanced exchange is important to reflect the diversity of perspectives, avoid an overemphasis on particular interests and allow beekeeping associations to effectively serve as intermediaries and representatives at different scales of beekeeping. Overall, through improved communication and exchange that support co-design and collaborative processes, synergies can be fostered among all beekeeping actors and conservationists who share the goal of promoting pollinator health.

7.4 | Implementation

Implementing the urban bee concept should be based on a complementary approach that combines top-down and bottom-up strategies, engaging the government, urban beekeeping associations and the broader social fabric (sensu Sponsler & Bratman, 2021) of beekeepers involved. Notably, once an appropriate set of measures is collaboratively decided upon with all stakeholders, they can be implemented in coordination with beekeeping associations and the support of local government authorities or conservation organizations. In this regard, beekeeping associations are critical in enhancing cohesion among beekeepers, coordinating actions and collaborating with other stakeholders (e.g. as in the case of the LBKA in London). Particularly, urban beekeeping associations enable urban beekeepers to learn and internalize social norms through social interactions and accountability (as discussed in Sponsler & Bratman, 2021). However, the diversity of urban beekeeping actors, with varying degrees of connection to one another, still presents a challenge. Some actors, such as corporate beekeeping companies, may not integrate easily with traditional beekeeping associations. Many individual beekeepers, especially hobbyists, may not be registered or, when so, may not be easily reachable, for example, via email lists or social media. Thus, they may be 'off the grid' regarding their activities. As a result, this complicates the identification of all stakeholders and their perspectives for practical conservation efforts and collaborations. Finding ways to foster cohesion and communication across diverse beekeeping actors is crucial to implementing mitigation measures and will require time and effort. In this regard, mandated registration of all beekeepers with an association or within a governmental programme (e.g. as in Switzerland, the USA, or Japan; Casanelles-Abella & Moretti, 2022; Matsuzawa & Kohsaka, 2022) can facilitate this. Similarly, regular newsletters, workshops, events and materials, among other initiatives, could benefit all active beekeeping actors in a city by fostering community and information sharing. Overall, the establishment of a social fabric among urban beekeepers, facilitated in part by beekeeping associations, is a critical step for the co-creation, re-evaluation, improvement and implementation of the urban bee concept.

8 | CONCLUSIONS

Beekeeping in urban areas requires new approaches to regulate this increasingly popular yet challenging activity. We have highlighted five critical aspects of urban beekeeping relevant to evaluating its social-ecological context and as a first step towards developing policies to mitigate the adverse impacts of urban beekeeping on wild bees and pollinators. Specifically, social-ecological regulatory frameworks can be co-designed, implemented and evaluated in collaboration with beekeepers and diverse stakeholders through the urban bee concept, which operates within a shared city landscape of mixed use. Such a concept is not static but must be updated and reevaluated periodically as new scientific evidence emerges. Furthermore, in a globalized world, unanticipated changes can occur rapidly, for example, through the introduction of invasive antagonist species (e.g. the Asian hornet in Europe, *Vespa velutina* Lepeletier, 1836), the outbreaks of diseases or through rapid shifts in climatic conditions, which in turn alter both managed and wild bees and their interactions. Research gaps and difficulties in implementing bee concepts in cities remain (Stange et al., 2017). However, the existing complexities and future uncertainties should not discourage but rather encourage the identification of solutions that will guarantee a future in which biodiversity, pollinator health and human interests coexist harmoniously in urban areas.

AUTHOR STATEMENT

Joan Casanelles-Abella and Monika Egerer conceived the idea and developed it together with all the co-authors. Joan Casanelles-Abella and Monika Egerer wrote the first draft. All authors corrected the manuscript and gave their approval for publication.

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CONFLICT OF INTEREST STATEMENT

Joan Casanelles-Abella is part of the scientific advisory board of the Swiss National Science Foundation Synergia project

BEENERGIA- Bridging Ecological and socio-Economic scieNces to Enhance our undeRstandinG of the Interactions between mAnaged and wild bees. Mark Patterson is a professional urban beekeeper and owner of the urban beekeeping consultancy Api:cultural. Monika Egerer is an associate editor for People and Nature, but was not involved in the peer review and decision-making process.

DATA AVAILABILITY STATEMENT

Data are archived in the repository EnviDAT (Casanelles Abella et al., 2024) under the following DOI: https://doi.org/10.16904/envidat.504. For Figure 4, data on hive distribution can be obtained from the Zurich Cantonal Veterinary Office (https://www.zh.ch/de/gesundheitsdirektion/veterinaeramt.html).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Text S1. Data on the distribution of beehives per beekeeping actor.

Text S2. Data on the growth patterns of urban beekeeping.

Text S3. Overview of available tools.

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