Comment on the paper “Citizens’ perceptions and willingness to pay for urban beekeeping: a case study in northern Italy” by Notaro et al. (2025)

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Abstract: The comment to the paper by Notaro et al. (2025) addresses the problem of the impact of beekeeping on the environment. Bees are crucial for the pollination of many wild and crop plants, and studies showing a decline in their numbers and species diversity are concerning and call for action. Setting up new apiaries may seem a logical way to enhance bee populations, but beekeeping is not a means of protecting bees and can itself be a threat to wild bee populations.

Keywords: honeybee, wild bees, apiaries, urban beekeeping

I read the paper by Notaro et al. (2025) on urban beekeeping with great interest. As a biologist, I rarely consider apiaries in cities from sociological or economic perspectives. Reading the article allowed me to broaden my horizon of thought. However, I have one concern about the paper: it depicts beekeeping as beneficial for the environment and biodiversity. While the authors do mention the threats posed by managed honeybees to wild bees, i.e. competition for food and disease transmission, and even include these threats in their questionnaire, I feel that the paper does not emphasise the gravity of the problem enough. It could create - or reinforce - the false belief that setting up apiaries is a way of helping bees and biodiversity. In reality, beekeeping can threaten bee biodiversity (Geldmann and González-Varo 2018). Furthermore, while some of the benefits of beekeeping are important in an agricultural context, they do not apply to urban environments to the same extent. Therefore, plans to set up apiaries in cities should be approached with caution.

The honeybee is currently a species with a very large population. In Europe, where it is native, most of its population consists of managed colonies or those that have escaped from apiaries and become feral. These managed colonies should be treated as farmed animals rather than wild pollinators. In areas where the honeybee has been introduced (e.g. the Americas and Australia), it is not part of the native biodiversity and may even be considered an invasive species (Cunningham et al. 2022). Despite facing several serious threats (e.g. pesticides and diseases), which have caused substantial losses of colonies in some parts of the world, the honeybee is not currently an endangered species. In contrast, the global population of managed honeybees has been increasing (Meixner 2010, Phiri et al. 2022).

Pollination is a key ecosystem service, and the current loss of biodiversity (Seibold et al. 2019) jeopardises its stability. Action must be taken to halt this loss. However, increasing the number of honeybees is not the ultimate solution, given that the honeybee is just one of a vast number of pollinator species. Pollination is also delivered by wild bees, wasps, moths, hoverflies, birds, bats and other taxa (Borchardt et al. 2024, Hahn and Brühl 2016, Rader et al. 2016). There are currently more than 20,000 known bee species (Orr et al. 2021). The numbers and diversity of wild bee species are declining (Zattara and Aizen 2021, Kosior et al. 2007, Goulson et al. 2008, Biesmeijer et al. 2006). Nevertheless, where they persist, they are often considered more efficient pollinators than honeybees (Garibaldi et al. 2013, MacInnis and Forrest 2019). Appropriate protection methods (e.g. increasing the number and diversity of flowering plants, providing more nesting space and reducing pesticide use) can support wild bee populations and ensure high-quality pollination services. Conversely, the managed honeybees might be indispensable pollinators where it is not possible to rapidly increase the number of wild bees. In large-scale monocultures where bee-friendly habitats are scarce, wild bee populations may be insufficient to pollinate the entire crop area. Site-specific conditions and limitations should be considered when choosing the optimal pollination strategy, which may involve using honeybees or other managed pollinators, supporting wild pollinators, or a combination of both (Isaacs et al. 2017).

Although urbanisation poses a challenge to many wild bee species, cities can support a surprisingly high level of bee diversity, including rare and endangered species (Banaszak-Cibicka and Żmihorski 2012, Fortini et al. 2024).For instance, 492 bee species have been recorded in Vienna, accounting for 70% of Austria's total bee species (Lanner et al. 2025), while 201 species have been identified in Bydgoszcz, representing approximately 40% of Poland's total bee species (Twerd and Banaszak-Cibicka 2019). Cities can be considered refuges from intensively managed agricultural land (Wenzel et al. 2020). If crops adjacent to the city are within the flight range of wild bees, urban bee populations can pollinate them (Langellotto et al. 2018). They can also provide individuals to colonise agricultural areas where biodiversity restoration measures have been implemented. Rather than increasing the number of honeybees in urban areas, protecting these diverse urban wild bee communities may be a more effective way of safeguarding pollination services. There are scientifically justified methods of protecting pollinators in urban areas (Zurbuchen and Müller 2012), with more being developed and tested (Braman and Griffin 2022). One such method is to plant nectar- and pollen-producing plants. Native species are particularly beneficial, but bees can also use ornamental plants of foreign origin (Prendergast 2023). Wild bees can also be supported by providing microhabitats for nesting. Most bee species nest in the ground; others use hollow plant stems, dead wood, empty snail shells, tufts of dry grass and other places (Zurbuchen and Müller 2012). Reducing exposure to pesticides and pollutants is also important for protecting wild bees (Goulson et al.

2015, Moroń et al. 2012, Moroń et al. 2014). It is worth noting that some of the aforementioned measures (increasing the food base, reducing pesticide use) benefit the managed honeybees as much as they benefit wild bees with which they coexist.

A growing body of research points to the present and potential threats posed by managed honeybees to wild bees (Iwasaki and Hogendoorn 2002, Prendergast et al. 2025). Surveys have been conducted in various habitats, including urban areas (McCune et al. 2020, Prendergast et al. 2021, Renner et al. 2021, Casanelles-Abella and Moretti 2022, Lanner et al. 2025). Urban beekeeping affects wild bees in cities by creating competition for food with tens of thousands of honeybee workers, as well as increasing the risk of parasite and disease transmission. The competition for resources between honeybees and wild bees is a subject of ongoing discussion and research. The analysis of functional traits indicates potential for competition (Lanner et al. 2025, Capellari et al. 2022). There are observational studies showing that wild bees and honeybees forage on different plant species (Boni et al. 2025) which may indicate low importance of competition. However, this differential foraging may also result from changes in wild bee foraging patterns aimed at limiting competition with honeybees, rather than being the result of species-specific food preferences. There are studies showing changes in wild bee behaviour (reduced flower visits and altered activity periods) in the presence of honeybees (Pasquali et al. 2025, Page and Williams 2023, Ropars et al. 2022). In addition to food competition, there is a risk of parasite and disease transmission. Spillover of pathogens from managed honeybees to wild bees threatens the latter (Fürst et al. 2014, Tehel et al. 2022). Pathogens can also be introduced to new areas with managed bee colonies, infecting wild bee species with pathogens that are new to them (Plischuk et al. 2009). Resource competition and disease risk do not act independently but are linked to each other and to other risks experienced by wild bees. A recent study showed that bumblebee colonies located closer to honeybee hives had a weaker immune response, a higher prevalence of a parasitic moth and lower reproductive success (Krams et al. 2025). The authors state that impaired immunity may result from increased competition with honeybees and can, in turn, increase the risk of infection with other pathogens.

Given the aforementioned threats to honeybees, establishing new apiaries could reduce, rather than increase, urban bee diversity. While urban beekeeping has some advantages (e.g. honey production; providing citizens with an interesting hobby; generating profits for beekeeping equipment manufacturers), increasing biodiversity or protecting the environment are not among them. Urban beekeeping is not a new phenomenon and honeybees are present in cities, sometimes in large densities (Matsuzawa and Kohsaka 2021, Bila Dubaić et al. 2021). Therefore, there is no urgent need to increase the number of their colonies. Before deciding to set up a new urban apiary, it would be advisable to analyse the size of the existing honeybee population and the availability of food sources. A Swiss study revealed that all 14 of the examined cities had insufficient floral resources to sustain existing honeybee colonies (Casanelles-Abella & Moretti, 2022), let alone support new ones..

The false belief that increasing the number of managed honeybees is a way to ‘help bees’ is firmly established among the public as evidenced by the results of Notaro et al. (2025): sentences stating that honeybees ‘are essential for ecosystem protection’ and that the respondent is ‘concerned about the decline of honey bee populations’ received high agreement scores, whereas scores for sentences about competition and disease transmission between honeybees and wild bees were much lower. We must be cautious about encouraging beekeeping, particularly in cities where a large population of managed honeybees is not required to pollinate large areas of crops, as may be the case in agriculture. Rather than suggesting that setting up apiaries is beneficial for biodiversity, we should inform people of the potential threats posed by beekeeping. Additionally, providing information on how to mitigate risks and safeguard wild bees within urban environments would empower citizens to effectively protect bees.

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References

Fortini L, Ruzzier E, Mei M, Di Giulio A (2024) The wild bees (Hymenoptera, Apoidea, Anthophila) of the urban nature reserves of Rome (Italy, Latium): a preliminary survey. *Biodiversity Data Journal*, *12*, e139087. https://doi.org/10.3897/BDJ.12.e139087

Banaszak-Cibicka W, Żmihorski M (2012) Wild bees along an urban gradient: winners and losers. *Journal of Insect Conservation*, *16*, 331-343. https://doi.org/10.1007/s10841-011-9419-2

Biesmeijer JC, Roberts SP, Reeme, M, Ohlemuller R, Edwards M, Peeters T et al (2006) Parallel declines in pollinators and insect-pollinated plants in Britain and the Netherlands. *Science*, *313*(5785), 351-354. https://doi.org/10.1126/science.1127863

Bila Dubaić J, Simonović S, Plećaš M, Stanisavljević L, Davidović S, Tanasković M, Ćetković A (2021) Unprecedented density and persistence of feral honey bees in urban environments of a large SE-European city (Belgrade, Serbia). *Insects*, *12*(12), 1127. doi.org/10.3390/insects12121127

Boni C, Coppola F, Sagona S, et al. (2025) Pollen Resource Repartition Between Managed Honey Bees (Apis mellifera L. 1758) and Unmanaged Bees in Three Italian National Parks. *Conservation*, *5*(1). https://doi.org/10.3390/conservation5010005

Borchardt KE, Holthaus D, Soto Méndez PA, Toth AL (2024) Debunking wasp pollination: Wasps are comparable to bees in terms of plant interactions, body pollen and single-visit pollen deposition. *Ecological Entomology*, *49*(4), 569-584. https://doi.org/10.1111/een.13329

Braman SK, Griffin B (2022) Opportunities for and impediments to pollinator conservation in urban settings: A review. *Journal of Integrated Pest Management*, *13*(1), 6. https://doi.org/10.1093/jipm/pmac004

Cappellari A, Bonaldi G, Mei M, Paniccia D, Cerretti P, Marini L (2022) Functional traits of plants and pollinators explain resource overlap between honeybees and wild pollinators. *Oecologia*, *198*(4), 1019-1029. https://doi.org/10.1007/s00442-022-05151-6

Casanelles-Abella J, Moretti M (2022) Challenging the sustainability of urban beekeeping using evidence from Swiss cities. *NPJ Urban Sustainability*, *2*(1), 3. https://doi.org/10.1038/s42949-021-00046-6

Cunningham SA, Crane MJ, Evans MJ, Hingee KL, Lindenmayer DB (2022) Density of invasive western honey bee (Apis mellifera) colonies in fragmented woodlands indicates potential for large impacts on native species. *Scientific Reports 12*(1), 3603. https://doi.org/10.1038/s41598-022-07635-0

Fürst MA, McMahon DP, Osborne JL, Paxton RJ, Brown MJF (2014) Disease associations between honeybees and bumblebees as a threat to wild pollinators. *Nature*, *506*(7488), 364-366. https://doi.org/10.1038/nature12977

Garibaldi LA, Steffan-Dewenter I, Winfree R, Aizen MA, Bommarco R, Cunningham SA et al (2013) Wild pollinators enhance fruit set of crops regardless of honey bee abundance. *Science*, *339*(6127), 1608-1611. https://doi.org/10.1126/science.1230200

Geldmann J, González-Varo JP (2018) Conserving honey bees does not help wildlife. *Science*, *359*(6374), 392-393. https://doi.org/10.1126/science.aar2269

Goulson D, Lye GC, Darvill B (2008) Decline and conservation of bumble bees *Annu. Rev. Entomol.*, *53*(1), 191-208. https://doi.org/10.1146/annurev.ento.53.103106.093454

Goulson D, Nicholls E, Botías C, Rotheray E L (2015) Bee declines driven by combined stress from parasites, pesticides, and lack of flowers. *Science*, *347*(6229), 1255957.https://doi.org/10.1126/science.1255957

Hahn M, Brühl CA (2016) The secret pollinators: an overview of moth pollination with a focus on Europe and North America. *Arthropod-Plant Interactions*, *10*, 21-28.https://doi.org/10.1111/een.12174

Isaacs R, Williams N, Ellis J, Pitts-Singer TL, Bommarco R, Vaughan M (2017) Integrated crop pollination: combining strategies to ensure stable and sustainable yields of pollination-dependent crops. *Basic and Applied Ecology*, *22*, 44-60. https://doi.org/10.1016/j.baae.2017.07.003

Iwasaki JM, Hogendoorn K (2022) Mounting evidence that managed and introduced bees have negative impacts on wild bees: an updated review. *Current Research in Insect Science*, *2*, 100043. https://doi.org/10.1016/j.cris.2022.100043

Kosior A, Celary W, Olejniczak P, Fijał J, Król W, Solarz W, Płonka P (2007) The decline of the bumble bees and cuckoo bees (Hymenoptera: Apidae: Bombini) of Western and Central Europe *Oryx*, *41*(1), 79-88. https://doi.org/10.1017/S0030605307001597

Krams R, Grigorjeva T, Willow J, et al. (2025) Infestation levels of Aphomia sociella in bumblebees increase with proximity to apiaries and result in lower reproductive output and weaker immune response. *Frontiers in Bee Science*, *3*, 1550560. https://doi.org/10.3389/frbee.2025.1550560

Langellotto GA, Melathopoulos A, Messer I, Anderson A, McClintock N, Costner L (2018) Garden pollinators and the potential for ecosystem service flow to urban and peri-urban agriculture. *Sustainability*, *10*(6), 2047. https://doi.org/10.3390/su10062047

Lanner J, Unglaub P, Rohrbach C, Pachinger B, Roberts S, Kratschmer S (2025) How many bees fit in the city? A spatial ecological case study to conserve urban wild bees. *Urban Ecosystems*, *28*(2), 21. https://doi.org/10.1007/s11252-024-01666-3

MacInnis G, Forrest, J R (2019) Pollination by wild bees yields larger strawberries than pollination by honey bees. *Journal of Applied Ecology*, *56*(4), 824-832. https://doi.org/10.1111/1365-2664.13344

Matsuzawa T, Kohsaka R (2021) Status and trends of urban beekeeping regulations: A global review. *Earth*, *2*(4), 933-942. https://doi.org/10.3390/earth2040054

McCune F, Normandin É, Mazerolle MJ, Fournier V (2020) Response of wild bee communities to beekeeping, urbanization, and flower availability. *Urban Ecosystems*, *23*, 39-54. https://doi.org/10.1007/s11252-019-00909-y

Meixner MD (2010) A historical review of managed honey bee populations in Europe and the United States and the factors that may affect them. *Journal of invertebrate pathology*, *103*, S80-S95. https://doi.org/10.1016/j.jip.2009.06.011

Moroń D, Grześ IM, Skorka P, Szentgyörgyi H, Laskowski R, Potts SG, Woyciechowski M (2012) Abundance and diversity of wild bees along gradients of heavy metal pollution. *Journal of Applied Ecology*, *49*(1), 118-125. https://doi.org/10.1111/j.1365-2664.2011.02079.x

Moroń D, Szentgyörgyi H, Skórka P, Potts SG, Woyciechowski M (2014) Survival, reproduction and population growth of the bee pollinator, Osmia rufa (Hymenoptera: Megachilidae), along gradients of heavy metal pollution. *Insect Conservation and Diversity*, *7*(2), 113-121. https://doi.org/10.1111/icad.12040

Notaro S, Paletto A, Mira A, Grilli G (2025) Citizens' perceptions and willingness to pay for urban beekeeping: a case study in northern Italy. *Urban Ecosystems*, *28*(2), 1-13. https://doi.org/10.1007/s11252-025-01681-y

Orr MC, Hughes AC, Chesters D, Pickering J, Zhu CD, Ascher JS (2021) Global patterns and drivers of bee distribution. *Current Biology*, *31*(3), 451-458. https://doi.org/10.1016/j.cub.2020.10.053

Page ML, Williams NM (2023) Evidence of exploitative competition between honey bees and native bees in two California landscapes. *Journal of Animal Ecology*, *92*(9), 1802-1814. https://doi.org/10.1111/1365-2656.13973

Paini DR (2004) Impact of the introduced honey bee (Apis mellifera)(Hymenoptera: Apidae) on native bees: a review. *Austral ecology*, *29*(4), 399-407. https://doi.org/10.1111/j.1442-9993.2004.01376.x

Pasquali L, Bruschini C, Benetello F et al. (2025) Island-wide removal of honeybees reveals exploitative trophic competition with strongly declining wild bee populations. *Current Biology*, *35*(7), 1576-1590. https://doi.org/10.1016/j.cub.2025.02.048

Phiri BJ, Fèvre D, Hidano A (2022) Uptrend in global managed honey bee colonies and production based on a six-decade viewpoint, 1961–2017. *Scientific reports*, *12*(1), 21298. https://doi.org/10.1038/s41598-022-25290-3

Plischuk S, Martín-Hernández R, Prieto L et al. (2009) South American native bumblebees (Hymenoptera: Apidae) infected by Nosema ceranae (Microsporidia), an emerging pathogen of honeybees (Apis mellifera). *Environmental Microbiology Reports*, *1*(2), 131-135. https://doi.org/10.1111/j.1758-2229.2009.00018.x

Prendergast KS (2023) Native flora receive more visits than exotics from bees, especially native bees, in an urbanised biodiversity hotspot. *Pacific Conservation Biology*, *30*(1). https://doi.org/10.1071/PC22033

Prendergast KS, Dixon KW, Bateman PW (2021) Interactions between the introduced European honey bee and native bees in urban areas varies by year, habitat type and native bee guild. *Biological Journal of the Linnean Society*, *133*(3), 725-743. https://doi.org/10.1093/biolinnean/blab024

Prendergast KS, Dixon KW, Bateman PW (2022) The evidence for and against competition between the European honeybee and Australian native bees. *Pacific Conservation Biology*, *29*(2), 89-109. https://doi.org/10.1071/PC21064

Prendergast K, Murphy MV, Kevan PG, Ren ZX, Milne LA (2025) Introduced honey bees (Apis mellifera) potentially reduce fitness of cavity-nesting native bees through a male-bias sex ratio, brood mortality and reduced reproduction. *Frontiers in Bee Science*, *3*, 1508958. https://doi.org/10.3389/frbee.2025.1508958

Rader, R., Bartomeus, I., Garibaldi, L. A., Garratt, M. P., Howlett, B. G., Winfree, R., ... & Woyciechowski, M. (2016). Non-bee insects are important contributors to global crop pollination. *Proceedings of the National Academy of Sciences*, *113*(1), 146-151. https://doi.org/10.1073/pnas.1517092112

Renner SS, Graf MS, Hentschel Z, Krause H, Fleischmann A (2021) High honeybee abundances reduce wild bee abundances on flowers in the city of Munich. *Oecologia*, *195*, 825-831. https://doi.org/10.1007/s00442-021-04862-6

Ropars L, Affre L, Thébault É, Geslin B (2022) Seasonal dynamics of competition between honey bees and wild bees in a protected Mediterranean scrubland. *Oikos*, *2022*(4), e08915. https://doi.org/10.1111/oik.08915

Seibold S, Gossner MM, Simons NK et al. (2019) Arthropod decline in grasslands and forests is associated with landscape-level drivers. *Nature*, *574*(7780), 671-674. https://doi.org/10.1038/s41586-019-1684-3

Tehel A, Streicher T, Tragust S, Paxton RJ (2022) Experimental cross species transmission of a major viral pathogen in bees is predominantly from honeybees to bumblebees. *Proceedings of the Royal Society B*, *289*(1969), 20212255. https://doi.org/10.1098/rspb.2021.2255

Twerd L, Banaszak-Cibicka W (2019) Wastelands: their attractiveness and importance for preserving the diversity of wild bees in urban areas. *Journal of Insect Conservation*, *23*, 573-588. https://doi.org/10.1007/s10841-019-00148-8

Wenzel A, Gras I, Belavad VV, Tscharntke T (2020) How urbanization is driving pollinator diversity and pollination–A systematic review. *Biological Conservation*, *241*, 108321. https://doi.org/10.1016/j.biocon.2019.108321

Zattara EE, Aizen MA (2021) Worldwide occurrence records suggest a global decline in bee species richness. *One Earth*, *4*(1), 114-123. https://doi.org/10.1016/j.oneear.2020.12.005

Zurbuchen A, Müller A (2012) Wildbienenschutz - von der Wissenschaft zur Praxis. Haupt Verlag AG, Zurich.

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