frontiers | Frontiers in Ecology and Evolution

TYPE Editorial
PUBLISHED 30 August 2023
DOI 10.3389/fevo.2023.1267880

OPEN ACCESS

EDITED AND REVIEWED BY
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RECEIVED 27 July 2023
ACCEPTED 22 August 2023
PUBLISHED 30 August 2023

CITATION
Sanllorente O, Cabrero-Sañudo FJ and Doña J (2023) Editorial: Urban insects: biodiversity, ecology, and conservation. *Front. Ecol. Evol.* 11:1267880. doi: 10.3389/fevo.2023.1267880

Editorial: Urban insects: biodiversity, ecology, and conservation

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KEYWORDS

biodiversity, conservation, ecology, insects, urbanization

Editorial on the Research Topic
Urban insects: biodiversity, ecology, and conservation

The urban habitat is a growing landscape on the Earth's surface affecting natural ecosystems (Groom et al., 2006; Aronson et al., 2014). According to UN data, the urban population is expected to increase by 200% by 2030 (Fragkias et al., 2013; United Nations, 2022). Given this imminent urban expansion, it is vital to deepen our understanding of how urbanization alters natural communities, aiming to reduce its impact on species diversity and ecological functioning (Gaston, 2010; Garrard et al., 2018). Assuming the key role that insects play in maintaining numerous ecosystem functions (Schowalter, 2013; Schowalter, 2022) and their frequent use as bioindicators of habitat quality (McGeoch, 2007; Chowdhury et al., 2023), studying their diversity within urban settings can offer valuable insights into the sustainability of these areas. However, research focused on urban insects remains limited. This Research Topic aims to contribute to our understanding of the insects in the urban environment under two perspectives: (1) as an altered landscape requiring understanding of its ecological functioning; and (2) highlighting the potential of green-blue infrastructures for urban development and insect diversity conservation.

Human-made landscapes, both urban and agricultural, often bring pollutants (but see Wang et al., 2023) impacting wildlife. In this sense, Mo et al. conducted experimental analyses to understand the effects of nitrogen inputs from fossil fuel emissions on soil arthropods, given their crucial role in nutrient recycling and soil formation. Their results suggest a threshold level of nitrogen: levels below 25 kg N ha^{-1} have a positive effect on diversity and abundance, while levels above 50 kg N ha^{-1} have a profoundly negative impact, particularly in the top 5 cm of the soil layer. Additionally, chemicals used for controlling pests (certain herbivorous insect species in overpopulation) that can cause substantial damage to vegetation impacting not only the ecosystem but also the economy due to losses in productivity and treatments (Raupp et al., 2012; Ansari et al., 2014; Dale and Frank, 2017). Hence, there has been an increasing focus on enhancing natural pest control methods using predators and parasitoids (Van Driesche and Bellows Jr, 2012). Chatelain et al. studied the arthropod community in three microhabitats, finding that urbanization affects arthropods in canopy and bush layers, but not those in tree bark. They concluded that some herbivorous species thrive due to the absence of predators, mainly

spiders. This predator absence can disrupt the food web, impacting, for example, insectivorous birds. Complementing these findings, McPike et al. investigates whether providing nutrients could support parasitoids (Hymenoptera: Braconidae) that control a pest (Lepidoptera: Gracillariidae) affecting a common urban tree species (*Fraxinus sp*). They found that the availability of carbohydrate supplements or nectar-providing flowers improves the longevity and fitness of these parasitoids, thereby increasing their chances of locating their hosts. In relation with food availability in urban areas and changes in behavior, Chen and Neoh's highlights that urban ants (Hymenoptera: Formicidae) exhibit smaller body sizes and have shifted their foraging patterns to align with human activity when food is more readily available, compared to their forest-dwelling counterparts. Additionally, urban ants have reduced heat tolerance and perform the function of particle removal less efficiently, compared to their counterparts in the wild.

The concept of green infrastructure, which combines urban development and green space conservation, has been recognized for its potential in addressing environmental issues (Ying et al., 2022), like mitigating the heat island effect (Abdulateef and Al-Alwan, 2022; Marando et al., 2022), reducing pollution (Abhijith and Kumar, 2020; Hewitt et al., 2020) and improving stormwater management (McFarland et al., 2019). Blue infrastructures, including ponds and their green surroundings, contribute to biodiversity, help mitigate global change, and provide ecosystem services (Wagner et al., 2013; Puppim de Oliveira et al., 2022). Aquatic insects, frequently used as bioindicators of water quality, play a critical role in maintaining these aquatic ecosystem functions (Suter and Cormier, 2015). In this Research Topic, three articles analyze insect diversity supported by different urban green-blue infrastructures. Diethelm and Masta investigate parasitoid wasps (Hymenoptera) on green roofs, revealing these roofs support a diverse wasp community, sufficient for pest control. Furthermore, roofs with herbaceous vegetation host more wasp species, due to the diversity of plant communities compared to *Sedum*-dominated roofs. Complementing this, Arjona et al. research how university campuses influence diurnal Lepidoptera and ground-dwelling Coleoptera diversity. They found that the diversity of butterfly species and beetle morphospecies is higher within university campuses compared to other areas, particularly in locations with less bare soil. University campuses also seem to buffer the negative impact of exotic vegetation on Coleoptera morphospecies richness. Both insect groups benefit from high herbaceous coverage and low maintenance activity. Lastly, Keinath et al. offer a unique study on the biodiversity of urban ponds, investigating fish, tadpoles, newts, and aquatic insects, as well as measuring certain abiotic parameters. They found that terrestrial surroundings had minimal influence on the overall aquatic insect diversity. However, it specifically impacted dragonfly (Odonata) abundance, likely due to their longer terrestrial phase as adults compared to other groups like Heteroptera or Coleoptera.

In sum, findings from this Research Topic provide new insights on several key areas:

Pollution's impact: Soil arthropod diversity is related to nitrogen levels, emphasizing the need to understand this balance for maintaining ecological stability.

Challenges in urban pest control: In certain habitats, the absence of natural predators can lead to herbivore surges, potentially resulting in population outbreaks. Additionally, providing additional resources to parasitoids enhances their efficiency in controlling these pests.

Insect urban adaptations: Urban ants have been closely examined for their behavioral and physical adjustments to urban pressures, revealing potential trade-offs.

Green-blue infrastructure's role: Green roofs and university campuses have been identified as urban spaces with the potential to foster insect diversity.

Author contributions

OS: Writing – original draft. FC-S: Writing – review & editing. JD: Writing – review & editing.

Acknowledgments

We thank the authors for their contributions and hope their work will help to better understand how to reconcile urban development and insect diversity conservation.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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