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PP-564 [Pollination and Bee Flora]

APIMONDIA SCANDINAVIA 2025 COPENHAGEN

URBAN AND PERI-URBAN CHALLENGES AND OPPORTUNITIES FOR POLLINATOR CONSERVATION IN SOFIA CITY, BULGARIA: PRELIMINARY STUDY

Student poster

Authors

Affiliation

Department of Landscape Ecology and Environmental Protection, Faculty of Geology and Geography, Sofia

Acknowledgments

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References

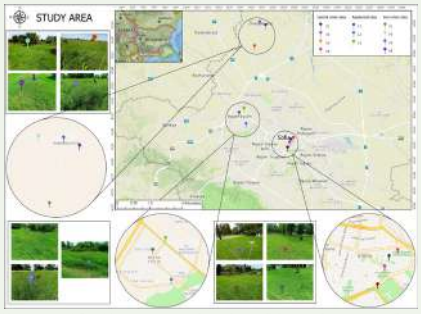
Apis mellifera on Aesculus ×carnea author's photo *Melitta leporina on Vicia grandiflora author's photo*

Introduction & Objective

Urbanization and climate change reshapes plant pollinator interactions, often by reducing diversity. But cities can also act as refuges when green spaces are well planed, managed and connected. This creates a need to understand not just who is present, how interactions are organized across urban gradients. We examine whether residential areas in Sofia, Bulgaria can function a stones between dense urban cores and peri urban habitats by analyzing network structure , and related properties, rather than species lists alone. By linking local interaction networks to landscape context, the study addresses a key gap for practical, city scale conservation and planning This approach could be also beneficial for beekeepers on where to place hives and when to plant or move them to keep forage

Study Area & Methodology

Research took place in and around Sofia, Bulgaria (42.6977 growing city with a mosaic of parks, inter block greens, roadsides, and unmanaged patches typical of post socialist urban fabrics. The continental climate (C January; ~580 mm precipitation) shapes flowering phenology and pollinator activity. We sampled three zones central parks/formal greens (the Lyulin residential district block lawns, mall adjacent greens, subway station), and peri field, hedgerow corridor, village green, periphery capturing contrasts and other conditions that could be



11

Study sites (64 m² each) across Sofia's urban gradient.

C1–C4: Central urban L1–L3: Residential P1–P4: Peri-urban

Standardized 30-min observations per site between 11:00–16:00.

Digital field data capture via custom AppSheet mobile app.

Dropdowns + GPS coordinates for every observation

Every interaction photographed using Sony Xperia 1 V.

Multi-stage species identification protocol.

Preliminary IDs via iNaturalist mobile ap & Atlas of European Bees

Expert verification afterwards

References: Gaizdic & Groom (2019); Pauly et al. (2011)

R

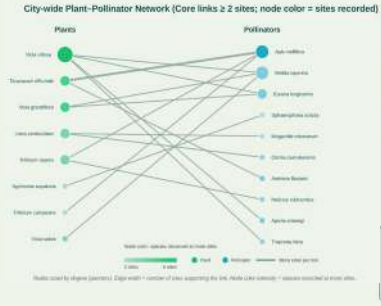
All analyses conducted in R 4.4.2 within RStudio environment.

dplyr tidyr bipartite igraph

Packages: Dormann et al. (2008); Csardi & Nepusz (2006)

The plot size was selected as a balanced approach, drawing on previous studies that utilized larger sampling areas in agricul al landscapes (Dupont et al., 2014) Metrics: nodes/edges, degree, density, components, , degree centralization, (NODF). Tests: ANOVA + Tukey HSD, Kruskal Wallis as needed; community composition with PERMANOVA (Bray

Results



Study Overview

40 Pollinator Species | 26 Plant Species | 86 Unique Links (≥10 visits)

Diversity by Urban Zone

Central Urban	Residential	Peri-Urban
LOWEST DIVERSITY	HIGHER DIVERSITY	HIGHEST DIVERSITY
11 pollinator spp	20 pollinator spp	21 pollinator spp
6 plant spp	8 plant spp	17 plant spp

Key Pollinators (by # of sites)

- Apis mellifera (5 sites)
- Anthemis flexipes (4), Acaena longicornis (4), Melitta leporina (4)
- Aphrodes bicinctus (4), Lasioglossum tricinctum (4)
- Anthemis wilhelmii (3), Halictus subcoriaceus (3)

Key Plants (by # of sites)

- Vicia villosa (5 sites)
- Vicia grandiflora (4), Taraxacum officinale (4)
- Lotus corniculatus (3), Vicia sativa (2), Trifolium repens (3)

Statistical Analysis

Species Richness

ANOVA: $F_{2,61} = 16.68$, $P = 0.0014$

Tukey HSD:

- Peri-urban > Central ($P = 0.0027$)
- Residential > Central ($P = 0.0039$)
- Peri-urban = Residential ($P = 0.996$)

Species Means ± SE

Central: 4.25 ± 0.75 spp

Residential: 8.67 ± 1.33 spp

Peri-Urban: 8.75 ± 0.95 spp

Abundance Analysis

ANOVA: $F_{2,61} = 4.16$, $P = 0.043$

Central: 7.25 ± 1.31 individuals

Residential: 11.33 ± 0.88

Peri-urban: 11.75 ± 1.11

Peri-urban vs Central $P = 0.051$ (marginal)

Network Structure

Nestedness (NODF):

- Central: ~40–100 (highest)
- Residential: ~28.6–46.2
- Peri-urban: ~34.1–41.4

Correlations:

- Nestedness vs Connectance: r = 0.74, P = 0.009
- No clear link with linkage-specialization

40 pollinator species city sites were the least diverse and least abundant sites were higher (see P values). Networks mirror this: the city core is most nested links tend to pile onto generalists rather than spread evenly.

Management Action

Residential green spaces can act as stepping-stones. Native seed mixes for courtyards/verges & stagger bloom; relax mowing to 4–6 weeks; cut pesticides.

Policy Solution

Diversify the "guest list"; ensure continuous bloom (spring – autumn) and add legumes (e.g., Vicia spp., Fabaceae & Asteraceae) to support specialists and reduce over-reliance on hubs.

Implementation Strategy

Protect & connect hedgerows, railroad verges, riparian strips. Specify corridor width/spacing in plans; pilot "biodiversity highways" links from the city core to the peri-urban edges.

Conclusion

Build the Bee Superhighways

Linear Corridors Work: Site P2 Success Story

Central City	Residential	Peri-urban
4.25 spp/site	8.67 spp/site	8.75 spp/site

P2 (hedgerow corridor): 15 spp — highest richness near monocultures

Preliminary patterns suggest that central urban urban areas may support greater richness and more even interactions. Completing the study this year and integrating and landscape metrics (patch size, connectivity, edge density) could help explore thresholds that predict richness and network indicate where interventions would be most effective.

PP-564 [Pollination and Bee Flora]
Urban and peri-urban challenges and opportunities for pollinator conservation in Sofia City, Bulgaria: Preliminary study

Milena Tocheva, Nikolay Nikolov
Department of Landscape Ecology and Environmental Protection, Faculty of Geology and Geography, Sofia University "St. Kliment Ohridski", Sofia, Bulgaria

Urbanization is reshaping ecosystems worldwide, threatening biodiversity but creating conservation opportunities through sustainable planning. Pollinators, which are crucial to ecosystem health and food security, face habitat loss. However, the potential for urban landscapes to serve as refuges for pollinators remains insufficiently explored. It is unclear whether urban environments can effectively support pollinator communities or how connectivity between urban and peri-urban areas might influence pollination. This study focuses on Sofia - a Balkan city with thousands of years of history, today the Capital of Bulgaria. The results are a part of urban flora-pollinators relationships study. Based on field work conducted in May 2024 at 11 sites (64m² plots, 30-minute observations) classified as Central Urban (inner city - densely built areas featuring significant green spaces like parks and public gardens), Residential (outer city - Lyulin District: high-rise buildings interspersed with green spaces), and Peri-urban (Dobroslavtsi Village: agricultural edges), we found that peri-urban areas supported approximately 60% more pollinators and nearly twice the species richness of central urban areas. A peri-urban site located at a hedgerow played a critical role in shaping these results, as it exhibited the highest pollinator diversity and abundance, highlighting its ecological importance. Statistical analyses confirmed these patterns, with ANOVA indicating a significant effect of area on abundance ($p = 0.043$), while GLMs showed significantly higher abundance in Peri-urban sites ($p = 0.0409$). Kruskal–Wallis tests supported significant differences in species richness ($p = 0.023$), reinforcing the role of site quality in shaping pollinator communities. While some abundance differences approached statistical significance, additional replication will be conducted this year to confirm these trends due to sample size limitations. These findings underscore the importance of outer city areas as stepping stones for maintaining pollinator populations across the urban-peripheral gradient. Strengthening ecological connectivity through green infrastructure - parks, gardens, semi-natural edges, and green linear corridors - could enhance pollination services and biodiversity. Effective landscape planning could improve habitat connectivity while balancing wild bees and Apis Mellifera L. populations to prevent competition for floral resources, ensuring diverse pollinator communities. This will benefit farmers, beekeepers, and urban agriculture, fostering synergies between conservation and livelihoods.