

Symposium 157: Bringing biodiversity to cities - conservation challenges in the urbanized world



Symposium and workshop

Tuesday 18th June 2024

Venue:

Aula E

Belmeloro Complex,

Via Beniamino Andreatta, 8,

40126 Bologna

Presentation

Urban land cover is increasing its proportion among the world's land uses and causing biotic homogenization and biodiversity loss. Additionally, more than half of the world's population live in cities now and according to current predictions, this will continue to increase dramatically in the near future, which makes the development of more sustainable and biodiversity-friendly cities an urgent goal. This goal is one of the most important challenges for the 2030 Agenda. To reach this goal there is an imperative need to explore and promote new approaches, such as nature-based solutions, green-blue infrastructures, urban design, management practices and citizen science initiatives, in order to enhance biodiversity on as many levels as possible. There is also an urgent need to develop conservation policies in the urban context; we need to integrate other dimensions that play an important role in the urban ecosystem, such as socio-ecological interactions between citizens and the environment.

The opening event of this programme is a workshop in which we will work on developing approaches to address both conceptual and practical challenges of urban ecological research. This will be followed by a symposium, in which researchers will present new results and initiatives on the conservation of urban biodiversity from a broad perspective, including plants, invertebrates and vertebrates. This is essential because preserving biodiversity requires the understanding of the conservation status of all ecosystem components ("thinking outside the box"). To sum up all these different perspectives and define an agenda for future urban ecological research, there will be a final discussion/round table at the end of the symposium, in which the conceptual and theoretical context for urban research will be discussed further, with the objective of developing research-based solutions and recommendations to help the planning and development of sustainable and biodiverse cities. We also hope that this event will result in the establishment of collaboration between groups of participants to work towards these goals.

Participants in this symposium (both presenters and audience) will have the opportunity of contributing to a Special Issue on the topic in a relevant, peer-reviewed scientific journal. Further details of this will be announced during the symposium.

Workshop - Progressing from taxonomic to conceptual and applied research in urban ecology

Lunchtime event 12:30-14:00 Tuesday 18th June

Venue: Aula E, Belmeloro Complex

Within the science of ecology, urban ecology is defined as the study of structure, dynamics, and processes in urban ecological systems. Urban ecology is the study of the relationships of human and nonhuman organisms in urban areas, the interactions of these organisms with the native and built physical environment, and the effects of these relationships on the fluxes of energy, materials, and information within individual urban systems and between urban and nonurban systems. Urban ecology applies the methods and concepts of the biological science of ecology to urban areas, but requires and integrates with the concerns, concepts, and approaches of social sciences to produce a hybrid discipline. Urban ecological systems include individual organisms, populations, communities, and landscapes, as well as buildings and infrastructure. Urban ecology further recognizes specific urban ecosystems as a part of the global biogeochemical, economic, and human demographic system. (Pickett & Cadenasso 2012)

The study of the ecology of urban areas began mainly with studies of vegetation of urban habitats during the mid 20th century. Researchers soon began to study other taxa, such as invertebrates. The 1990s saw a number of large-scale projects aimed at investigating the ecological effects of urbanization. As is often the case, these projects tended to generate more questions than answers. One result of this research has been the publication of a copious amount of textbooks on urban ecology, which has now become firmly established as a scientific discipline. At the turn of the millennium, a number of prominent researchers were calling for efforts to develop a body of concepts and theory for urban ecology. Today, we would like to take up that challenge again. Our objective is to (1) reflect together on what has been already achieved in urban ecological research, and to (2) consider what conclusions can be provided for municipalities to help them conserve urban nature and biodiversity. We will also consider (3) how we can make more effective use of the considerable volume of data that has been generated by urban ecological research, from the earliest studies of the mid 20th century to recent work. Finally, we will consider (4) how data from urban ecological research can be used in conceptual and theoretical research.

We hope that the workshop will be attended by people from a diverse range of backgrounds, both scientists and practitioners, encompassing diverse research roles and interests and also municipal representatives familiar with the research requirements of cities.

The workshop will begin with a brief discussion about the context. We will then divide into a number of small groups to work separately on the topics outlined above. One possibility will be for these small groups to go and enjoy lunch together whilst discussing their topic. After the small group work, we will reconvene to discuss the findings of the small group work and discuss these within the whole group. We hope that one of the outcomes of this work will be small and diverse groups that will continue to collaborate on topics related to the themes of this workshop and that this might provide an impetus for future research projects and other scientific outputs.

Symposium Tuesday 18th June

Moderators: Lucía Izquierdo, Olivia Sanllorente and Stephen Venn

Venue: Aula E

14:30 Welcome and Introduction.

Speaker: Olivia Sanllorente

14:35 Urban grassland habitats for the conservation of insect diversity.

Speaker: Stephen Venn

14:50 What factors drive the presence of ant communities in Mediterranean unsealed schoolyards?

Speaker: Louise Eydoux

15:05 Insects in cities: A within-cityscape ecological systems approach to reveal mechanistic processes that shape urban flying insect communities.

Speaker: Atilla Çelikgil

15:20 The impact of urbanisation on diversity, performance and fitness of cavity-nesting Hymenoptera: insights from a large-scale citizen science project.

Speaker: Panagiotis Theodorou

15:35 The hidden ecology of urban garbage: food waste may indirectly simplify urban bird communities.

Speaker: Daniel Lipshutz Forrest

15:50 Urban development type drives differences in avian-mediated regulating ecosystem services.

Speaker: Lucía Izquierdo

16:05 Coffee break

16:30 How much are Eastern European city parks buffered against urbanization?

Speaker: Tamás Lakatos

16:45 Wealth and wildlife in cities: understanding economic and demographic influences to aid urban biodiversity conservation.

Speaker: Irene Regaiolo

17:00 A new tool to assess urban biodiversity: a non-disruptive protocol to characterize the root systems and their interactors.

Speaker: Gabriella Sferra

17:15 Bringing nature to urban gardens: studying attitudes of garden owners towards environmental friendly practices.

Speaker: Orsolya Valkó

17:30 The New Normal: Ethnobiology of cities and urban ecological knowledge.

Speaker: Ani Bajrami

17:45 Discussion and Closure

Moderators: Lucía Izquierdo, Olivia Sanllorente and Stephen Venn

18:00 End of session

Abstracts

Urban grassland habitats for the conservation of insect diversity

Stephen Venn

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Urban areas are very challenging for the conservation of biodiversity. Urban green infrastructure can contain mosaics of diverse habitat types, often including habitats with high potential for biodiversity, though urbanization also filters assemblages. This filter retains taxa that are resilient, and excludes taxa that are vulnerable. I hypothesize that taxonomic and specific traits determine this level of resilience or vulnerability of different taxa. In this study, I use data on selected insect taxa (bees, butterflies and carabid beetles) from subsets of a network of approximately 40 grassland habitats in Helsinki, Finland, sampled between 2008-2012. Using data on traits of species and taxa, I determine which environmental factors, and which traits, are most critical for determining urban grassland insect assemblages. I then use this information to make recommendations on planning green infrastructure for conserving insect diversity.

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Tzoulas, K., Galan, J., Venn, S., Dennis, M., Pedrolí, B., Mishra, H., Haase, D., James, P., Niemelä J. & Pauleit, S. (2020) A dynamic and adaptive framework for implementing nature-based solutions in sustainable urban development and healthy cities, *AMBIO* DOI 10.1007/s13280-020-01380-2

Venn, S.J., Kotze, D.J., Lassila, T. & Niemelä, J.K. 2013 Urban dry meadows provide valuable habitat for granivorous and xerophilic carabid beetles *Journal of Insect Conservation* 17: 747-764

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Venn, S., Novitsky, R., Vershinin, V. & Kreuzberg, E. (2018) Urban Ecosystems in Isabel Sousa Pinto, Victoria Elias, Markus Fischer, Piero Visconti IPBES Regional Assessment for Europe and Central Asia – SOD 3 Chapter 3: Status, trends and future dynamics of biodiversity and ecosystems underpinning nature's contributions to people.

What factors drive the presence of ant communities in mediterranean unsealed schoolyards?

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The process of removing the impermeable top layer of soil, i.e. soil unsealing, is increasingly advocated by public policy. Despite recognized anthropogenic advantages such as water cycle regulation, the role of unsealed areas in soil biodiversity conservation remains understudied.

The objective of this study is to elucidate the impact of specific attributes of unsealed areas on ant colonization, a prominent group within soil biodiversity. We thus sampled 14 unsealed schoolyards in and around the city of Montpellier (France), investigating ant communities through the placement of 655 baits on unsealed plots. We tested two variables: the duration since soil unsealing (1 or 2 years) and the type of soil cover (wood chips, mulched plantations or grassed areas).

Our study facilitates an initial inventory of a previously unexplored environment. Remarkably, these areas act as habitats for ants from their very first years of creation: a rich diversity has been observed and notable changes in ant communities were evident within a single year. Additionally, wood chip-covered areas are significantly less rich and abundant in ants compared to other ground cover types. These preliminary findings signify a promising starting point for soil biodiversity conservation but require further exploration before guiding future unsealing operations.

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Insects in cities: A within-cityscape ecological systems approach to reveal mechanistic processes that shape urban flying insect communities.

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Urbanisation is one of the main drivers of land-use change with negative effects on biodiversity. Yet, insect communities have been shown to have contrasting responses to urbanisation with varying effects on their species richness and abundance. Here, we used a multiple spatial scale (small-scale mechanistic to landscape scale), interdisciplinary (ecological and socio-economic) within-city approach to investigate the impact of urban development on flying insect communities in two German cities. For this, we used pan traps in the cities of Hamburg and Leipzig at 245 sites that spanned from the edge to the city centre and collected several local patch (temperature, nesting and floral-food resources) and landscape ecological variables, as well as socioeconomic factors that could affect insect communities. Overall, we collected more than 10,000 insect individuals and identified more than 21 hoverflies, 33 Coleoptera, 160 Hymenoptera, and 4 Lepidoptera species. Preliminary analyses revealed a negative relationship between impervious surfaces and species richness and a strong positive effect of local flower richness on insect biodiversity. Further analyses will provide insights into how environmental and socioeconomic factors can influence insect species and their functional traits and highlight key processes necessary to inform strategies to restore and maintain diverse urban insect communities.

The impact of urbanisation on diversity, performance and fitness of cavity-nesting Hymenoptera: insights from a large-scale citizen science project

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Urban development can affect population dynamics, ecological interactions and fitness and challenge the persistence of many species, including bees. Yet, how and which urban environmental features affect bee diversity, foraging patterns, parasitism, life history, and fitness remain unclear. Here, we used a citizen science approach and cavity-nesting Hymenoptera in insect hotels as a model system, to investigate Hymenoptera community diversity, larval diet, parasitism, mortality, and reproductive output. In total, 286 insect hotels were used in two German cities at sites that span from the edge into a city's core and several environmental variables were collected from each site. Overall, more than 10,000 and 2,000 individuals belonging to 12 cavity nesting bee and 23 wasp species, respectively, were sampled in all insect hotels and cities. Preliminary statistical analyses revealed a strong negative relationship between impervious surfaces and cavity-nesting Hymenoptera species richness and reproductive output. In addition, the proportion of urban green land uses was positively related to species richness and parasitism rate and indirectly to mortality. As cities expand worldwide, our study aims to highlight the main urban environmental factors that influence cavity-nesting bees and wasps and can help guide conservation management to reduce the adverse consequences of urbanisation on Hymenoptera.

The hidden ecology of urban garbage: food waste may indirectly simplify urban bird communities

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Urbanization is now a leading cause of biodiversity loss. Yet, the processes structuring urban ecological communities are poorly understood. Most urban ecology investigates direct effects (e.g., competition, fragmentation), though ecologists have long recognized that indirect effects (e.g., trophic cascades) contribute to community composition in “wilder” spaces. We explored direct and indirect mechanisms that determine bird community composition in a case study of Vancouver, Canada. We hypothesize that, by inadvertently augmenting populations of scavengers (e.g., American crows) via food waste, people subsidize nest predation and undermine Vancouver’s bird diversity.

We surveyed bird diversity, abundance, food waste availability, and microhabitats across 14 varied transects in Vancouver. We triangulated these data with high-resolution land cover data. We then fit Bayesian hierarchical models to infer the relative effects of food waste and other variables (e.g., land cover, seasonality) on bird diversity and abundance.

Preliminary results indicate that food waste availability is positively associated with crow abundance and negatively associated with species richness, and crow abundance is negatively associated with species richness.

Our findings indicate that complex, indirect interactions likely structure urban communities, and warrant greater research attention. Additionally, interventions that reduce the food waste available to wildlife may augment urban biodiversity.

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Urban development type drives differences in avian-mediated regulating ecosystem services

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The fast expansion of urban areas drives multiple impacts on ecosystems such as the loss of biodiversity and the process of biotic homogenization, having direct consequences in animal-mediated ecosystem services such as regulating ecosystem services (RES). Urban areas are developed in a gradient that varies between two extremes: land sharing (small and fragmented green patches) and land sparing (large and continuous green areas). This landscape gradient and other local urban attributes (e.g. vegetation cover type) are related with changes in urban bird community composition. However, little is still known about whether they can affect animal-mediated ecosystem services. To investigate this, we carried out bird censuses in nine cities in Europe during breeding and winter season. We extracted diet information from each species identified, allowing us to calculate four RES: fruit dispersal, pollination, pest control and scavenging. The results show that land-sharing favor higher levels of avian-mediated RES, although there are differences between seasons. We also found an important effect of certain vegetation types and perturbation characteristics. These results provide new insights on the discussion on how to build more biodiversity-friendly cities by improving ecosystem functioning.

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How much are Eastern European city parks buffered against urbanization?

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Human-induced habitat alteration is among the greatest threats to global biodiversity. Urbanization and associated habitat loss pose enormous pressure on native ecosystems. But at the same time, urban areas open new opportunities for biodiversity conservation, as protected areas alone are no longer sufficient. We studied bird communities and their functional traits in 10 medium-sized cities in the Carpathian Basin, spread over two countries (Hungary and Romania). Our study design focused on urban and suburban parks and agricultural and deciduous forest edges neighbouring the studied cities, representing an urbanization gradient. Our results showed that bird species richness was highest at the forest edges, and lowest in the urban parks, whereas urbanization did not affect abundance. Regarding the functional traits, mainly small-bodied birds were present in the cities and at the forest edges, just like species nesting on higher levels. Suburban parks favoured granivores, and those species that feed on higher locations were only observed at the forest edges. Non-migratory species were significantly more numerous in urban and suburban parks. Our finding demonstrates a strong urbanization effect in these mid-sized cities, but in some cases, urban parks harboured functionally important species as well, emphasising the positive role of urban green infrastructure.

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Wealth and wildlife in cities: understanding economic and demographic influences to aid urban biodiversity conservation

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Urban biodiversity enhances quality of life and can foster conservation actions, but its benefits are not shared equitably among citizens. The positive correlation between biodiversity and socioeconomic status within cities (the Luxury Effect) represents a measure of environmental injustice. Understanding the drivers of this common but not universal relationship will help to promote more equitable cities and biodiversity conservation worldwide. We undertook a meta-analysis examining links between the strength of environmental injustice and socioeconomic variables in terms of terrestrial biodiversity. There was evidence for the Luxury Effect within cities. This relationship was stronger in wealthier cities and in countries with a lower GDP. There were non-linear relationships between human population size and the Luxury Effect, but no support for an effect of income inequality. The results suggest that poorer societies do not have the economic resources to confront environmental injustice, likely investing less in conservation actions. Non-linear models generally provided a better fit, supporting the theoretical background of the association between economic development and its environmental impacts. We suggest that non-linear associations are considered routinely in Luxury Effect studies. Further research is needed in under-represented countries in the developing world, which are likely those with greater environmental injustice.

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A new tool to assess urban biodiversity: a non-disruptive protocol to characterize the root systems and their interactors

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Plants attract and support microbial and animal communities and play a key role to guarantee functional and healthy urban habitats based on biodiversity. The mutual interactions among the components of the plant-centered holobiont are basilar for resilience and their comprehensive analysis would be beneficial to link the functionalities with the plant performance, especially for trees. In this perspective, evaluating the root system health and role in the plant-centered holobiont ecosystem would be crucial not only for stability and management but also for conserving/monitoring/managing biodiversity and for environmental safety. Thus, we developed an innovative non-invasive protocol to characterize the root systems and their interactions with the abiotic/biotic components of the holobiont unit. With aim of characterizing urban biodiversity, as part of the recovery and resilience plan (PNRR) driven by National Biodiversity Future Center (NBFC) of which the University of Molise is partner, we applied in urban contexts this protocol combining traditional root morphology and physiology descriptors with advanced methods relying on omics approaches integrated with imaging-based data and modelling assisted by bioinformatics. Data were collected and used to implement a database of root functional traits to be exploited for the modelling and prediction of developmental trends by machine learning.

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Bringing nature to urban gardens: studying attitudes of garden owners towards environmental friendly practices

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Gardens are often decorated with non-native plants, which make them potential starting points of invasions. Using native plants adapted to the regional soil and climatic conditions instead of non-natives can decrease the invasion risks. In our project (<https://www.vadviragoskertem.hu/>), we ask people to choose 5 of 24 native wildflower species and offer seeds for decorating their gardens. In a questionnaire, we ask about reasons for choosing a certain set of species and about attitudes towards environmental-friendly practices in gardening. We aim to create a community of people interested in environmental-friendly gardening and will address follow-up questions about the establishment of the wildflowers. So far >5,000 people from 946 settlements in Hungary joined the project. We aim to increase social awareness and raise the profile of native plants as important components of urban biodiversity, and develop a seed mixture that can successfully establish in gardens and offer attractive alternative to non-native species.

The New Normal: Ethnobiology of cities and urban ecological knowledge

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Urban ethnobiology is a scientific discipline focused on relationships and interactions between people and living things in urban ecosystems. In the face of overpopulation, climate change and Capitalocene, those relationships and interactions, part of people's systems of beliefs, values and perceptions and embedded in urban ecological knowledge, it is of great importance to identify, document and interpret this type of knowledge, especially in major cities, including those of people's living in the capital city of Albania, Tirana. In this article we will try to give insights on today's major trends in urban ethnobiology and the basic notions which accompany them, and to address the why's and how's to conduct future ethnobiological studies in our cities. That is because these kinds of studies are absent. Additionally, in line with today's scientific methods and communications technologies developments, we recommend that during ethnobiological fieldwork it is crucial the involvement and engagement of communities living in cities, through community-based research approach and citizen science projects for a meaningful and sustainable future.

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Symposium Organizers



Lucía Izquierdo

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I am PhD student focused on the effects of urban areas on bird biodiversity and human-nature interactions (Ecosystem services, cultural values and perceptions)



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