

**UNIVERSITÀ DEGLI STUDI DI MILANO-BICOCCA**  
***DOTTORATO DI RICERCA IN Tecnologie Convergenti per i Sistemi***  
***Biomolecolari – XL CICLO***

**Research Topic ID: XL – 1.2**

**Proponent:** Dr. Paolo Biella

**Project Title:** Reversing human impact on pollinators: assessing the efficiency of actions promoting the pollination ecosystem service in human dominated environments

**Scientific background and ‘open issues’**

Human activity alters natural systems and it could dramatically impact the ecosystem services provided by biodiversity (Cardinale et al., 2006; Ollerton et al., 2014; Schmid et al., 2009). Among these services, pollination by animals is of global importance given the economic and health benefits, for their role in food security and primary ecological processes (Lautenbach et al., 2012; Potts et al., 2016). However, given their importance, pollinator decline could have drastic effects on human nutrition and health (Smith et al., 2015).

Since the increasing rate of urbanization, it is a priority to disentangle factors that are harmful or beneficial to pollinators. The environmental conditions of cities impact pollinators by causing stresses that can affect the pollination service (e.g. overheating by a warming city climate). At the same time, some urban features could benefit pollinators with gardens where to find resources (Leong et al., 2018) or forests acting as refuge areas (Baldock, 2020). Under these conditions, it is urgent to characterize with the technological advances the risks of pollinators, for guaranteeing sustainability and human health through pollination by animals.

**Objectives**

The project will address open questions in the context of sustainability and human well-being, with special attention to the ecosystem services by pollinators and the role of human activities.

The first aim will characterize the effect of greening actions (urban reforestation). This scope will focus especially on pollinator biodiversity in relation to urban reforestation programmes. The goal is to describe the role played by reforestation programmes and flower-planting actions in keeping the biodiversity-mediated ecosystem service of pollination.

As a second aim, the project will compare different practices supporting pollinators in intensive agricultural or urban areas. Thus, this action will link biodiversity to management and green area structure and it will further tune existing ways for the mitigation of the impacts. This scope will deepen our understanding of how reforestation programmes could benefit pollinator fauna and in turn enhance functional biodiversity in agreement with SDGs plans of the Agenda 2030 and the one-health concept.

**Methodologies**

The methodology will include both established and novel methods of surveying the functional biodiversity of pollinators as well as of characterizing the ecosystem pollination service, including molecular identification with DNA. Areas of surveying will be mainly urban areas, from large parks to small community gardens, to intensive agricultural areas, the field activities will take place in three major Italian cities and the surrounding countryside.

Environmental parameters will be measured with Remote Sensing, in field sensors and detailed census for instance of the forest size, shape and structure. Landscape analyses will also be performed. Existing measures for supporting pollinators will be characterised in detailed with in depth surveys in the study areas measuring elements as herbs cover, sward height, flower diversity. With these data, statistical models will be fitted to describe the variation of pollinator functional diversity and the ecosystem service of pollination in relation to the aims explained above.

### **Collaboration / Co-tutoring opportunities**

The PhD project will interact with local and national initiatives such as ForestaMi, Vivaio Bicocca, European Life+ project 'Apistrada dei Fiori' with Parco Nord Milano, among others.

### **Project's Sustainability & Mobility**

- The project fully agrees with the ongoing research lines of the supervisor.
- Pertinent articles by the proposer:

Biella, P., Akter, A., Ollerton, J., Nielsen, A., Klecka, J., 2020. An empirical attack tolerance test alters the structure and species richness of plant–pollinator networks. *Functional Ecology* 34, 2246–2258. <https://doi.org/10.1111/1365-2435.13642>

Biella, P., Tommasi, N., Guzzetti, L., Pioltelli, E., Labra, M., Galimberti, A., 2022. City climate and landscape structure shape pollinators, nectar and transported pollen along a gradient of urbanization. *Journal of Applied Ecology* 59, 1586–1595. <https://doi.org/10.1111/1365-2664.14168>

Tommasi, N., Biella, P., Maggioni, D., Fallati, L., Agostinetto, G., Labra, M., Galli, P., Galimberti, A., 2023. DNA metabarcoding unveils the effects of habitat fragmentation on pollinator diversity, plant-pollinator interactions, and pollination efficiency in Maldivian islands. *Molecular Ecology* 32, 6394–6404. <https://doi.org/10.1111/mec.16537>

- Putative foreign institution: Charles University (Prague, Czech Republic)

### **References**

Baldock, K.C.R., 2020. Opportunities and threats for pollinator conservation in global towns and cities. *Current Opinion in Insect Science, Ecology • Parasites/Parasitoids/Biological control* 38, 63–71. <https://doi.org/10.1016/j.cois.2020.01.006>

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- Ollerton, J., Erenler, H., Edwards, M., Crockett, R., 2014. Extinctions of aculeate pollinators in Britain and the role of large-scale agricultural changes. *Science* 346, 1360–1362. <https://doi.org/10.1126/science.1257259>
- Potts, S.G., Imperatriz-Fonseca, V., Ngo, H.T., Aizen, M.A., Biesmeijer, J.C., Breeze, T.D., Dicks, L.V., Garibaldi, L.A., Hill, R., Settele, J., 2016. Safeguarding pollinators and their values to human well-being. *Nature* 540, 220.
- Schmid, B., Balvanera, P., Cardinale, B.J., Godbold, J., Pfisterer, A.B., Raffaelli, D., Solan, M., Srivastava, D.S., 2009. Consequences of species loss for ecosystem functioning: meta-analyses of data from biodiversity experiments. *Biodiversity, Ecosystem Functioning, and Human Wellbeing: An Ecological and Economic Perspective* 14–29.
- Smith, M.R., Singh, G.M., Mozaffarian, D., Myers, S.S., 2015. Effects of decreases of animal pollinators on human nutrition and global health: A modelling analysis. *The Lancet* 386, 1964–1972. [https://doi.org/10.1016/S0140-6736\(15\)61085-6](https://doi.org/10.1016/S0140-6736(15)61085-6)