

## **Abstract**

Biodiversity loss is a known problem of increasing importance. While causes of biodiversity loss are diverse, we as humans are the greatest contributors due to our overuse of the Earth's resources.<sup>1,2</sup> Urbanization increases biodiversity loss, reducing liveable habitat for many animal and plant species by demanding space and resources for settlement, industry, and agriculture, and producing waste and polluting adjacent areas. While the negative effect of cities is obvious, cities also have great potential to create natural habitats (urban green spaces) in any space.<sup>3,4,5</sup> Such urban green spaces, including gardens, public parks, and balconies, are essential for several animal species, especially insects. Insects are not only crucial to our agricultural production, pollinating roughly one third of our crops.<sup>6,7</sup> Insects are also most affected by intensive green space management.<sup>8,9</sup> In turn, many birds, mammals, amphibians, and reptiles are also affected, as insects represent a major food source. Thus, insects are good indicators of the state of biodiversity, and gardening for insects can help conserve it.

Many studies found that although there is a general interest in gardening for wildlife, native, and thus insect-friendly vegetation is still often perceived as untidy. While research on the perception of such insect-friendly green spaces mostly focused on gardens or public green spaces, balconies have received less attention.

By using a questionnaire my research aimed at developing insights that help to define strategies to overcome insect-diversity impeding factors in balcony gardening by answering the following questions:

1. What do people generally associate with balconies? This included connections to insect diversity and tidiness. I further examined balcony uses among different groups and compared the uses of balconies to those of gardens.
2. How do people perceive balconies with native vegetation that promotes native insect diversity in comparison to balconies without vegetation and balconies with non-native vegetation that do not promote native insect diversity? Here, I also wanted to know the factors influencing the perception and if there were comparisons to gardens and public green spaces.
3. Which factors are relevant in influencing people's decision about using plants that support native pollinators on their balcony?

I distributed the questionnaire online via the software "Unipark" (EFS release 22.1) and to random locations in Stuttgart's neighbourhoods (Baden-Württemberg, Germany). Participants were asked for their perception (associations and feelings) of three different balcony designs. These included a bare balcony without vegetation ('noveg'), and the same balcony once with

non-native, non-insect-friendly vegetation ('exotic'), and once with native, insect-friendly vegetation ('insect'). Participants with balconies were further asked about uses of their balcony and what would contribute to them starting to garden for insects. Answers for the perception were translated into positive (+1), negative (-1), and neutral (0) values. The data was then analyzed and visualized in R (version 4.2.0). To examine the influence of selected factors on the perception, I performed likelihood ratio tests based on Generalized Mixed Effect Models (GLMM) and ranked the models according to Akaike's second order Information Criterion (AICc) to find the model fitting the observed data best.

Like gardens, balconies were mostly used for relaxation and observation. Nearly half of the participants also stated to garden for insects on their balcony. The uses differed among many groups, most strongly pronounced in age, awareness level, and interest in and knowledge about gardening for insects. The analysis of the perception of the three balcony designs showed that participants clearly preferred any vegetation over none, with the novel design displaying a significantly more negative perception than the exotic and insect design.

While insect mentions were rare, they were still mostly connected with the insect design, and correct connections were made after participants had been asked to rank the designs' attractiveness to native insects. Nevertheless, the insect design also received the most negative mentions concerning the perceived tidiness, which is in line with previous research.<sup>10</sup> While it was difficult to make out factors influencing the perception for the whole study population, influential factors for balcony owners were easy to identify. Knowledge about insect-friendly gardening strongly influenced the number of insect-friendly plants and structures and lead to a more positive perception of the insect design. Balcony owners felt more time and space would most likely contribute to them gardening for insects. This shows that there are misconceptions about the maintenance level of native, insect-friendly plants, as they actually require less time and care than exotic species. Furthermore, people assume insect-friendly gardening can only be done big scale, even though even the smallest spaces may contribute to the conservation of insect diversity.

Most of my results were consistent with previous research, showing that balconies are not too different from gardens concerning both use and perception. As for gardens and public green spaces, preferences for different vegetation types were likely to be caused by different lifestyles and life stages, which in turn influenced environmental awareness.<sup>11</sup> Nevertheless, balconies seem to offer an even more private space than gardens, as neighbours' opinions were rarely mentioned to influence gardening practices on the balcony. The reason for this may well be the floor level, as balconies are on higher floors and thus less open to public view. To further examine this difference, I suggest comparing lower floor balconies (e.g., first floor) to gardens. Given the misconceptions about the needed maintenance of insect-friendly vegetation, and its perceived unkemptness, education of the public remains the greatest task.

The focus should hereby lie more on a bottom-up approach, involving citizens in science projects and educating them alongside, but also in their daily life including information in for example in garden centres.

## Literature

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