The living world above our heads: How city trees help shape biodiversity

July 13 2022, by Bastien Castagneyrol and Elena Valdés-Correcher

The pine processionary caterpillar, covered with stinging hairs that spark fear into city dwellers. Credit: Wikimedia, CC BY-SA

Trees and cities are not rivals—at least, no longer entirely. The ambitious tree-planting programs we have witnessed in cities over the past years are proof of urban dwellers' passion for them.

But there is a paradox in this: cities continue to spread at the expense of natural areas, breaking up habitats and removing woodland to make way for impervious surfaces that store and give off heat, such as concrete.

Urban trees are often presented as a "nature-based solution" that helps cool down cities. However, trees also play a more understated role that is just as vital: they provide lasting support for the living world.

Researchers have long gauged biodiversity according to the number of species present in a given environment. They are now increasingly realizing the importance of another dimension: the extent to which species interact with one another.

Indeed, species have been able to adapt to environmental restrictions thanks to their interactions with others than their own. Such connections are hard-wired within them through evolution. For instance, urban white clovers were recently found to have lost their capacity to emit chemicals in defense of herbivores.

While we increasingly understand how urbanization impacts upon plants and their enemies, there effectively remain significant research gaps, be them geographical (Africa or South America are current blind spots) or

scientific (how our towns shape species interaction or local food chains).

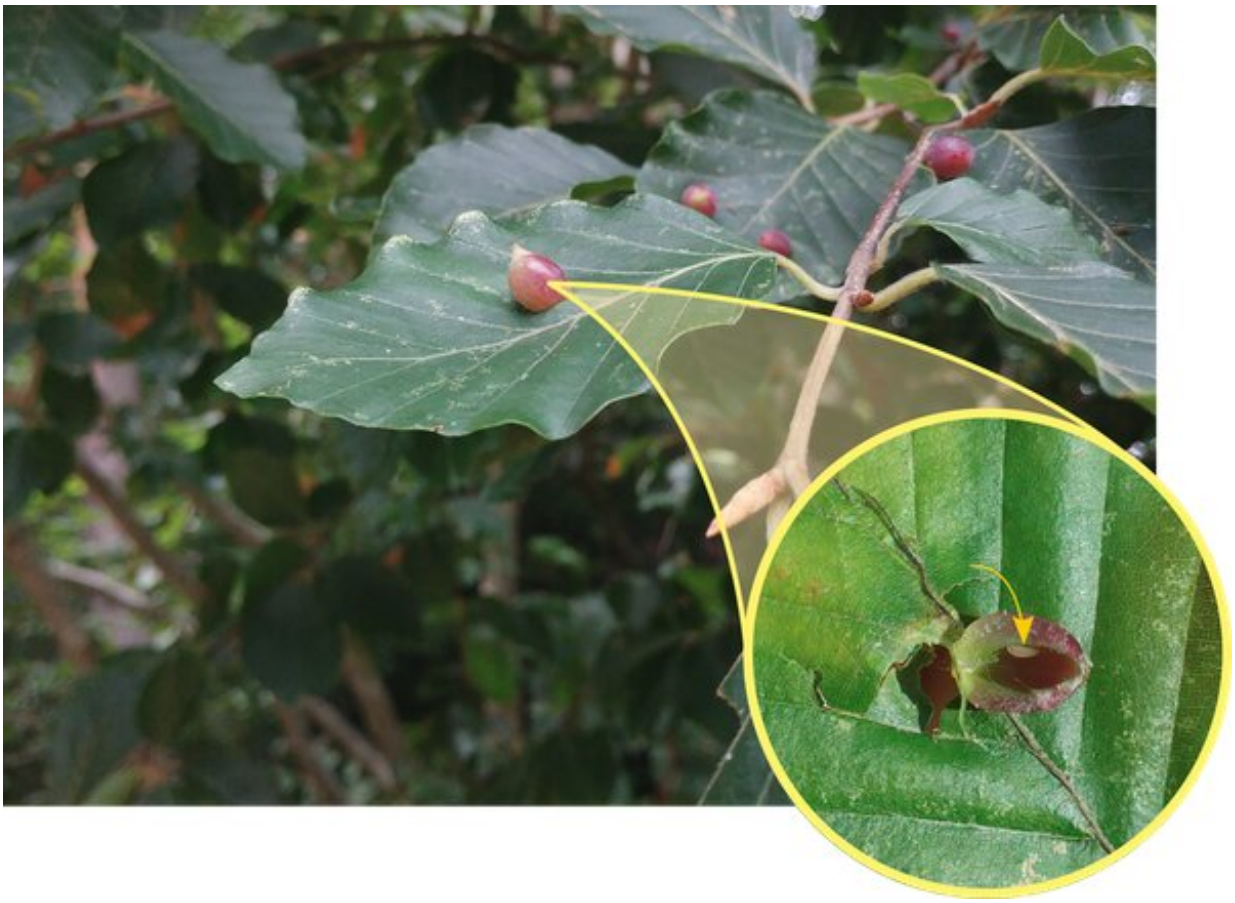
Cities' rich and overlooked ecosystems

Trees and woods in cities provide shelter for a wide range of organisms. City-dwelling readers might think of those small bugs sucking off the sap of plants, aphids, whose maple-like excrements drip onto car roofs or bicycles parked under lime trees; the famously unnerving pine processionary caterpillars that thrive in warmer towns, or the starlings that find shelter between the leaves at night. We could go on.

Such organisms constantly interact with trees and with one another. Look up to an oak tree and you can see traces of herbivorous insects that have passed by: leaves gnawed by caterpillars and punctured by sap-hungry aphids and heteropterans.

In turn, predators—especially birds—prevent such insects from stripping the trees bare by preying on them.

Together, trees, herbivorous insects and insectivorous birds constitute robust ecosystems. Their intrinsic links allow them to hold up against external disturbances like bad weather.



An example of a gall formed by a beech leaf. The gall provides shelter for a herbivorous insect larva. The insect helps form the gall, which gives it shelter and food. Credit: The Conversation

Uncharted interactions

Much research has shown urbanization standardizes biodiversity, which is more alike between two cities in the same region than between a given city and its surrounding countryside. This shapes interactions between organisms and, by extension, the dynamics of biodiversity and so-called *ecosystem services* city dwellers are provided with, such as cooler and cleaner air.

It would be wrong to think life is equally spread across within the city, however. If two towns from one region look more alike than an urban center and its greenbelt, differing tree density from one district to another tend to turn towns into biological patchworks.

Researchers at North Carolina State University found areas with fewer trees provide herbivores with fewer resources. This, in turn, cuts down their numbers, and spares the trees from their devastating appetites. On the other hand, researchers at the University of Queensland, Australia, have also shown conservation of fully developed trees in city streets helps maintain bird diversity.

The more trees there are, the more insects attack them

We studied the heterogeneity of biodiversity among urban trees as part of a Europe-wide participative science project.

Fifty-two schools and forty-one scientists took samples of oak leaves in seventeen countries. Some were from cities, others from the countryside. By examining the 18,060 leaves all the project partners sent us, we were able to study the impact of urbanization on insects linked to the pedunculate oak (*Quercus robur*) in the bulk of its area of distribution in Europe.

We observed contrasting effects from impervious surfaces (typical of urbanized zones) and from tree density on herbivorous insects linked to oak trees: oaks surrounded by many trees sustained more attacks on average (suggesting greater abundance and diversity of herbivores), whereas oaks growing in highly urbanized zones underwent fewer attacks. These results were expected.

What was less expected was our finding on how tree density can alleviate the impacts of urbanization. This was particularly true for insects that

form galls on leaves and those leaf miners that dig galleries within them: while the numbers of leaf miners were overall lower in towns, they proved slightly higher in areas with trees offering shelters against stressful climatic conditions.

In sum, our study shows urban trees not only give us pleasure, but prove to be precious allies in the global fight against the loss of our ecosystems and life-support systems.

At the very least, we should keep a watchful eye on the domino effect of any action carried out on urban trees, given our understanding of the complex interactions between trees and urban biodiversity is still limited. We will be pursuing our work next year, with new schools taking part in the project.

Provided by The Conversation

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