European Platform UrbanGreening

A systematic view on biodiversity monitoring in urban environments

January 15th &16th, Valencia; April 15th 2024, Houten

International Day For Biological Diversity

Next month, 22th may 2024, it's the International Day of Biological Diversity [International Day for Biological Diversity | United Nations](). So, let's talk a bit more about biodiversity in urban environments.

What is biodiversity?

Biodiversity or biological diversity is the variety and variability of life on earth. Biodiversity is a measure of variation at the genetic (genetic variability), species (species diversity), and ecosystem (ecosystem diversity) level. Urban biodiversity is the specific variety and abundance of natural life in a city.

GENETIC DIVERSITY

Diversity of genes within populations

SPECIES DIVERSITY

Diversity among species in an ecosystem or habitat

ECOSYSTEM DIVERSITY

Diversity of a habitat in a given unit or area

What indicates balanced biodiverse ecosystems in cities?

Ecological balance is a term used to describe the balance between living organisms such as humans, plants and animals and their environment. Ecological balance is important as it leads to the continuous existence of organisms. It ensures that a particular genre is not abused or overused. For example, too many wasps, mosquitos or oak processionary caterpillars in an area could be an indicator for a disbalanced ecosystem. If these species exceed the healthy population numbers, they become a pest. A balanced ecosystem is beneficial for the system as a whole, where an ecosystem in disbalance could be favourable for one specific (dominant) species and detrimental for another species.
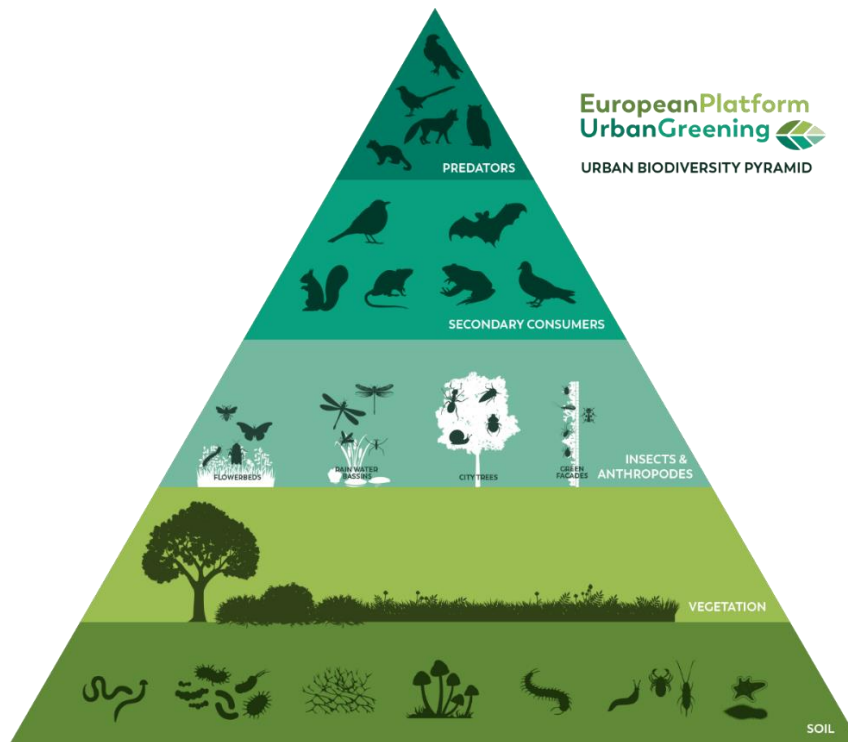
Disbalance: wasp on a terrace with only pavement;
Balance: wasps in a system with natural enemies (dragonflies, other insects, spiders, frogs and birds eat wasps).

Although many insect species are not doing well due to human actions, the opposite seems to be true with mosquitoes. "Mosquitoes often thrive in the presence of disturbances," Schrama explains. "Many other insects, such as butterflies, need stable and undisturbed ecosystems." If vulnerable insects disappear, there is less competition for the mosquito. Schrama gives an example: "Many insects have disappeared in Europe over the last years due to drought, but mosquitoes did benefit from this. When waters that normally never dry up suddenly become parched, mosquitoes can colonize the place very quickly. This type of periodic drought causes fish, amphibians and other types of insects that normally target mosquitoes to disappear." Disbalance occurs. [1]

[1] [1]https://www.universiteitleiden.nl/nieuws/2020/08/menselijke-verstoringen-van-ecosystemen-leiden-tot-een-toename-van-ziekteverwekkende-muggen.

Pyramid of a balanced ecosystem in urban areas

Explanation of the urban biodiversity pyramid

Species in the urban soil

A tablespoon of healthy soil hosts more individual living organisms than there are people on the planet. Worms, mites, centipedes, fungi, and bacteria are all working hard to keep the soil and your plants healthy. These underground organisms have multiple functions and cycle nutrients, aerate soil, and stabilize soil pH levels, for example. They also prey on garden pests and provide food for wildlife.

Examples of indicator species: earthworm (*Lumbricus*), Fungi, Bacteria and nematodes.[2]

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[2] Source: https://blog.scienceborealis.ca/digging-into-soil-health/
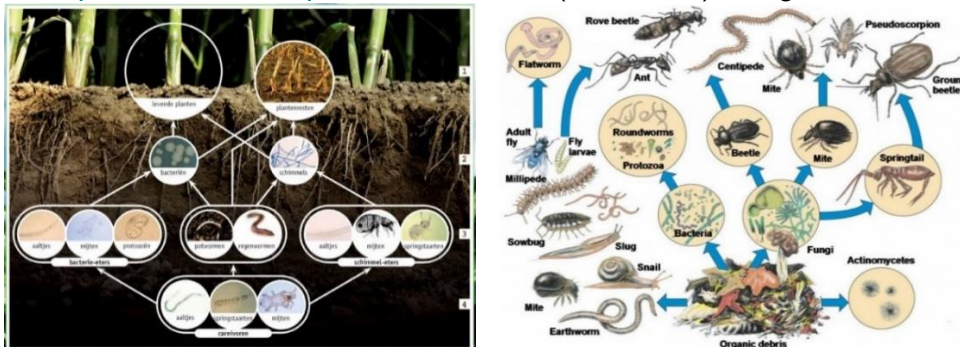
Urban vegetation (plants)

Specific for urban habitats and functions:

Indicator species can and will be different in every city and even within a city. Depending on other tasks (e.g. climate adaptation, attractiveness for people etc.), a local ecologist will be able to identify the exact indicator species per site. The following indicators will most likely be part of the list:

- Native plants (sown or spontaneous) are preferred. Native plants provide ecological benefits, favoring an increased biodiversity, better air quality, and improved water quality. This is because they are symbiotic to native soil and fauna.
- If it is not possible to use native species, choose species with a value for fauna. For example, fruit-bearing species for birds. Or valuable plants for wild bees and butterflies, so called 'gestation plants'. Gestation plants are plants, flowers, shrubs and trees that provide food or nectar for insects.
- City trees are important because a tree is a whole biotope in itself. It is an environment with homogeneous biological properties that is home to different species: animals, plants, fungi and microorganisms. Its role is fundamental in the fight against the extinction of species. Global warming, the destruction of the living environment and pollution are among the main factors behind the disappearance of species. Trees are very important in the fight against climate change. They harbor life, nesting and food supply, while offering protection to many species. Even when it's dead, a tree continues to support insects and shelter animals, such as night owls.

Insects & anthropodes (primary consumers) within four specific urban habitats:

- *Flowerbeds*: solitary bees *(for example Hoplitis en Osmia),* butterflies/moths/caterpillars, flower flies.
- *City trees*: tree hoppers (Membracidae family), ants, beetles, aphids, caterpillars.
- *Green facades*: spiders, ladybugs (Coccinellidae family), Aphid Lions (Chrysopidae family), ground beetles (Carabidae).
- *Rainwater basins*: dragonflies, damselflies, water Striders (Gerridae family), mosquitoes.

Secondary consumers

The secondary consumers are birds (for example sparrow, tit, finch, pigeon, swallow, blackbird), amphibians, rodents, bats and other small mammals.

Birds are not only found in woods, fields, meadows and mountains. Many species penetrate deep into cities and towns. As a rule, the more diverse the environment, the greater the number of species that live there. When there's large, mature trees, permeable surfaces, or even city parks and gardens with native trees, bushes and shrubs present, the number of bird species increases significantly.

Predators

Predators are birds of prey or raptors (such as owls, falcons, buzzard), crow, magpie, fox and marten. Wild-living raptors die from many causes, including weather, disease, accidents, starvation, territorial fights, and predation of nestlings. Raptors are increasingly drawn to cities, mainly by the availability of both prey and urban forested areas. Urban environments present the same risks that raptors face in the wild as well as risks unique to city living. Chief hazards for urban raptors are increased risk of collisions (such as with windows, wires, and vehicles), concentration of environmental poisons, and human persecution.[3]

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[3] From: https://urbanraptor.org/seattle-urban-raptors/threats-to-urban-raptors/
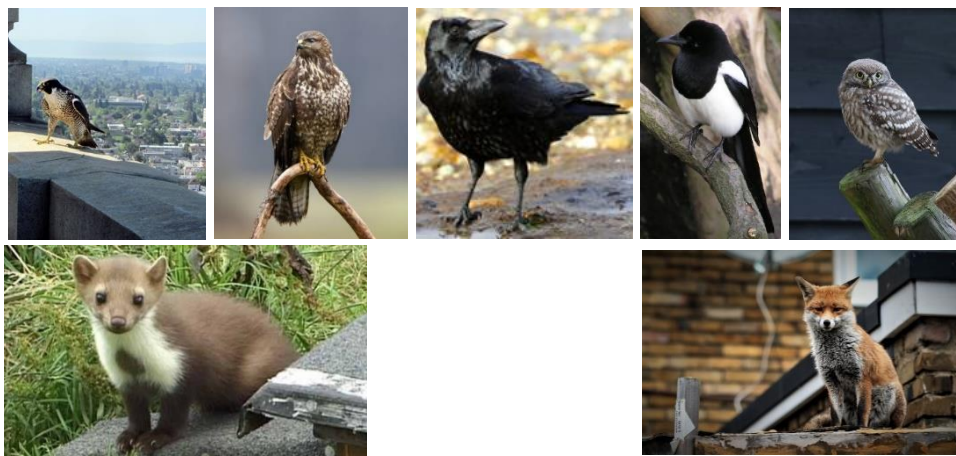
Which specific urban factors have an impact on biodiversity?

Pollution
- Air pollution affects plant and insect populations.
- Water pollution does not only affect water life but also has an effect on vegetation and animals that depend on these water sources. It can disrupt food chains.
- Soil pollution may cause plants to become toxic, therefore harm consumers and thus, reduce the availability of suitable habitats.

Light
Light can cause a disruption of day and night rhythms. It can disrupt growing, feeding and mating behavior of species. Especially nocturnal animals are particularly vulnerable.

Noise
Noise and city sounds are also a problem, because it interferes with communications among species. It disrupts mating calls, navigation and predator-prey interactions.

Pets
An abundance of cats and dogs disrupt the natural predator-prey interaction. Mankind also has released caged bird species (such as parakeets and love birds) and released water turtles that are a threat to native species. Because of climate change, these species can survive.

Isolation
Green spaces are often isolated green areas that prevent species to migrate. Thus, habitats become too small.

Measuring biodiversity

Promoting biodiversity is an important goal in many scientific disciplines, ranging from ecology and biology to environmental sciences and agriculture. The methods scientists use to study and promote biodiversity are very diverse. The choice of methodology depends on the research question, the type of organisms being studied, the available resources and the characteristics of the research area. Multiple methods are often combined to obtain a more complete picture of biodiversity in a particular ecosystem. Measuring biodiversity as a whole is almost undoable, due to the complexity of the system. What can be done is the measuring of indicator species. They represent a broader complexity. For each group of indicator species you need to have a local ecologist or expert (for example a foodweb specialist). If you want to start, we suggest you focus on vegetation and flying insects. Measuring vegetation is not that complicated. There are several digital applications to help you to do so.

Especially regarding to monitor flying insects you can use Camera-trap survey: Cameras are placed in strategic locations to photograph or film wildlife as they pass. In Yuverta Houten we use the flying insect camera 'Diopsis' from Faunabit: https://faunabit.eu/. At the Green Academy in Denmark and at Malvesia in Valencia we are using the insect camera 'Faunaphotonics': https://faunaphotonics.com/. Both camera systems are still in the development phase and are being improved each day in collaboration with schools and companies.

Citizen science
By involving the general public in collecting biodiversity data, scientists can benefit from a large number of observations that would otherwise be difficult to obtain. This can be done, for example, through mobile apps that allow citizens to report sightings of plants and animals. An example of this is the app 'obsidentify'[4]. All kinds of local of national nature organizations also have their own programs such as the national bird count, butterfly count, bee count, etc.

In summary: Promoting biodiversity often requires an integrated approach that combines different methods and disciplines. Scientific studies and interventions are crucial for the conservation and sustainable management of biodiversity in global ecosystems.

For more information regarding to measuring biodiversity: Biodiversiteit | Nederlands Instituut voor Ecologie (NIOO-KNAW) and Onderzoeksdata | Nederlands Instituut voor Ecologie (NIOO-KNAW)

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[4] https://waarneming.nl/apps/obsidentify.