



Monitoring ground-dwelling beetles in the Living Lab community garden. Photo: Anneli Karlsson, City of Andernach.

Beetles in an urban community garden can indicate global warming

Beetles were surveyed using pitfall traps in a community garden in Andernach, Germany. Two years of data revealed a beetle fauna characteristic of sandy, warm and dry habitats. Sporadic findings include species typical for the Mediterranean.

BETLES ARE INDICATORS FOR PEST CONTROL AND ECOSYSTEM HEALTH

For decades, scientists have been recording ground-dwelling beetles by catching them in traps in the ground. For this group of animals, results can be easily compared between studies because the recording method can be standardized. Typically, the traps are made using jam jars buried in the ground, with the opening at soil level. Beetles fall into the trap and land in a liquid, e.g. concentrated saline, which kills the beetles and keeps them well preserved until the traps are emptied and re-set.

Despite the high number of individuals caught, the number of animals removed corresponds to only a very small fraction of the beetles occurring in

a study area. Nevertheless, trapping is carefully regulated to make sure it does not have negative effects on beetle populations or other wildlife. License to kill is granted because the monitoring provides required information about the beetles in an area. Changes in beetle species and their abundances over time can indicate changes in general ecosystem health.

A MAJORITY OF GROUND, ROVE AND LEAF BEETLES

In 2021, ground-dwelling beetles were trapped between March 12th and June 30th. The traps were placed in three rows of five jam jars, each row in a different part of the field. The first row was along a plot of Jerusalem artichoke on the edge of a strip



Examples of pitfall traps. Photos: Günay Bayramov, University of Koblenz (left); Anneli Karlsson, City of Andernach (right).

The City of Andernach hosts a Living Lab in the EU Innovation Action ‘Edible Cities Network’. Coordinated by the city administration, the Living Lab has been implemented through co-creation with public and private institutions, enterprises and individuals. The Living Lab includes different Edible City Solutions, namely a variety of urban food gardening initiatives: Wastewater use, Aquaponics (permaculture), Beehives, Seed production of local and rare pea species, High beds (permaculture, schools and kindergartens), a Fertilizer experiment (permaculture), Action days and a Community Garden. As part of the Innovation Action, economic, social and environmental impacts of Edible City Solutions are assessed. To contribute to ecological sustainability, no pesticides are used in the garden.



Phacelia field (left) and the Jerusalem Artichoke (right). Photos: Anneli Karlsson, City of Andernach.

of trees, the second was along a plot of *Phacelia* flowers, the third row was next to the mountain bike track of the youth centre neighbouring the Living Lab.

A total of 1,594 individuals from 129 species were recorded. As expected, ground beetles were the most species-rich beetle group, with 35 species, followed by rove beetles with 24 species, leaf beetles with 18 species, and weevils with 13 species.

BEETLE NOMENCLATURE

English name	Scientific name
Ground beetles	Carabidae
Rove beetles	Staphylinidae
Scarab beetles	Scarabaeidae
Leaf beetles	Chrysomelidae
Weevils	Curculionidae
Ladybirds	Coccinellidae

The most common species was the ground beetle *Harpalus affinis*, represented by 347 individuals over the entire study area, which makes up almost a quarter of all beetles recorded. Other common ground beetle species were *Nebria salina* (158 individuals), the small bombardier beetle *Brachinus explodens* (148 individuals), the common sun beetle *Amara aenea* (105 individuals), and *Microlestes minutulus* (93 individuals). These species are common for the beetle fauna in relatively warm locations with dry and sandy soils in the Rhineland and throughout Central Europe.

The small bombardier beetle, as well as two other species that we found, *Asaphidion pallipes* and *Amara*

apricaria, are on the German “early warning list”. These are species that are not yet considered as threatened and therefore not on the Red List, but whose populations are declining, such that they may become threatened if the trend continues. These species do not thrive in the dense vegetation typical on intensively managed farmland.

Ground beetles are predators, known to be important in controlling insect pests on farms. This family of beetles is ecologically extremely diverse. In Rhineland-Palatinate alone, 369 species have been identified. They are also well investigated, which makes them a popular group for ecological and nature conservation studies and in monitoring programmes.

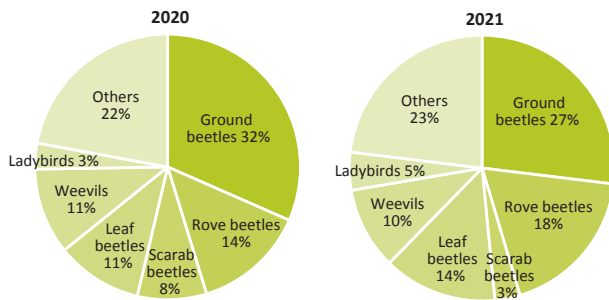
Astrapaesus ulmi stands out among the rove beetles as a peculiarity. It is the third specimen found in Germany and the first specimen in Rhineland-Palatinate. Until 2015, only very old finds were known in Germany, the validity of which is doubtful. This finding highlights that beetle trapping not only records the most common species, but can also lead to amazing, completely unexpected new discoveries.

MINOR DIFFERENCES BETWEEN 2020 AND 2021

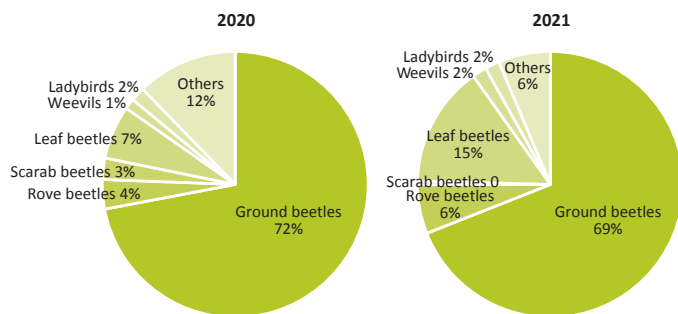
In 2020, ground beetles were recorded from March 23rd to July 14th, using the same method as in 2021. In 2020, ten traps were used in four different locations, compared with fifteen traps in three locations in 2021. In 2020, 922 beetles from 95 species were recorded. There were only minor differences between the two years in the groups with the greatest number of species and individuals.



The small bombardier beetle (*Brachinus explodens*) (left) is a quite common ground beetle in the Living Lab community garden, whereas the rove beetle *Astrapaesus ulmi* (right) stands out as a peculiarity for Germany. Photos: Christoph Benisch (left), Marian Slamka (right).



Similar proportions of **species** in the most commonly recorded beetle groups over two years.



Similar proportions of **individuals** in the most commonly recorded beetle groups over two years.

An individual of the ground beetle *Ophonus brevicollis* was found to be a faunistic rarity in 2020. This beetle has previously only been detected twice in Germany and this was the first sighting in Rhineland-Palatinate.

A STEPPE FAUNA WITH SOUTHERN-EUROPEAN SPECIES

Many of the species found are characteristic of sandy, warm and dry habitats. Originally, such habitats only existed in small areas on the banks of large rivers in Central Europe. Through the clearing of large areas for the expansion of agriculture, these habitats

became more frequent and the associated fauna more widespread. The beetle fauna in the Living Lab community garden can therefore be characterised as a steppe fauna with many immigrant species. This fauna is fundamentally threatened by the massive use of pesticides on intensively used farmland. The species-rich fauna, with the occurrence of threatened and rare beetle species that we found, shows how important it is to have areas free from pesticides.

RARE FINDINGS MAY INDICATE GLOBAL WARMING

The past few years until 2020 were among the warmest and driest since records began in the heat-favoured Rhine Valley. Year 2021 has also been warm, although much more humid. The beetle fauna of the Living Lab was basically adapted to warm, dry conditions already. This is proven, for example, by the astonishing frequency of the two bombardier beetles *B. crepitans* and *B. explosens*. However, we can interpret the occurrence of great rarities in the beetle fauna, *Ophonus brevicollis* in 2020 and *Astrapaues ulmi* in 2021, which have their distribution focus in the Mediterranean area, as an effect of climate change. Like other extremely dry-adapted insect species, these two are evidently spreading northwards. They will probably lose their status as “great rarities” north of the Alps and become part of an increasingly “Mediterraneanized” fauna in Central Europe.

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