



Can Green Roofs Provide Habitat For Invertebrates In An Urban Environment?

**by
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Introduction - Green Roof and Biodiversity PhD

This brief report provides an overview of the first long term study of green roofs and biodiversity in the UK. The research was undertaken between 2004 and 2007. This study continued on from an MSC project at UCL in 2002.

1. Green Roofs

Green roofs encompass both intensive ornamental roof gardens and extensive roofs with more naturalistic plantings or self-established vegetation. Green roofs have wide ranges of environmental benefits such as they improve the thermal performance of the buildings, and prolong the life of the roofs. Green roofs reduce levels of carbon dioxide in the atmosphere and improve oxygen levels. Furthermore they improve air-quality by filtering dust and airborne particles. Green roofs also reduce rainwater run-off and enhance water quality. In addition green roofs have psychological benefits for people through their aesthetic appeal, moreover they enhance biodiversity in the urban environment.

1.1 Extensive Green Roofs

Extensive roofs refer to more naturalistic planting, with a depth of between 30-150 mm substrate, which are either sown with grass mixes or left to colonize naturally or established using *Sedum* matting. They have two main varieties, (i) Green/*Sedum* roofs, or (ii) Brown/Biodiverse roofs, designed primarily for biodiversity.

(i) *Sedum* Roofs

(a) *Sedum* mat

A *Sedum* mat consists of pre-grown *Sedum* plants on a porous polythene blanket with usually 2cm of growing medium. This mat is rolled out onto a thin (30-40mm) substrate. A variety of *Sedum* plants is used because they are wind, frost and drought resistant.

(b) Substrate based *Sedum*

Seven cm of crushed recycled brick [with a degree of organic material] is laid out on a drainage/moisture blanket system and plug planted with *Sedums*.

(ii) Brown/Biodiverse Roofs

Brown/Biodiverse roofs are extensive green roof systems. They differ from *Sedum* roofs in that they are composed of substrate with varied depth between 50 to 150 mm, usually of crushed brick or concrete, supplemented with organic matter. This is either sown with wild flower seed mixtures or allowed to colonize naturally.

2. The Study

The main aim of the study was to examine the biodiversity value of green roofs, and to record, demonstrate and quantify the invertebrates that live and breed on these roofs. This study took place over a three-year period and was the first of its kind in the UK. The study has highlighted that **green roofs do provide habitats for invertebrates**. These habitats offer a valuable resource in the urban environment, as in many cases these roofs are the only available resource in the local area. Not only do green roofs offer habitat for invertebrates, but they can also increase invertebrate populations by ten fold compared to ordinary, grey roofs.

The most remarkable fact about green roof habitats is that they host a very high percentage of species of local or national interest. On both green and biodiverse roofs, on average 20% of the spiders and 15% of beetles recorded had either a local or national importance, including Notable and Red Data Book species. All the Red Data Book species were beetles, which require specific habitats, including coastal sites and even salt marshes. Many Notable spiders were collected from biodiverse roofs, which are normally found on brownfield sites. As such a high percentage of rare invertebrates were found on biodiverse roofs, this suggests that biodiverse roofs can be designed to replace conditions of specific habitat types at ground level.

Furthermore, both green and biodiverse roofs host abundant invertebrate populations. Almost 10 % of the whole UK national and almost 20 % of the Greater London spider fauna was recorded from these four green and six biodiverse roof sites. This data highlights the conservation value of these roof habitats.

As nearly all of the rare invertebrates found on the roofs colonized from distant brownfield sites, the most important factor for the long-term survival of rare invertebrates is **habitat quality** rather than connectivity. If suitable good quality habitat is provided, invertebrates will colonize the roofs from some distance. Consequently providing even small patches of good quality habitats such as brown/biodiverse roofs in the city is vital for the long-term survival and conservation of invertebrate fauna in the urban environment.



Red tailed bumblebee feeding on a cornflower on Grays Inn Road Biodiverse roof

3. *Sedum* v Biodiverse roofs

***Sedum* roofs** generally supported a more abundant, but less diverse invertebrate community than biodiverse roofs. *Sedum* roofs, which are supplied with a thin substrate, are less likely to sustain the initially high invertebrate populations. Shallow (less than 3-4 cm) substrates are less likely to hold water and nutrients in harsh environmental conditions experienced on the roofs. Green roofs with deeper recycled crushed brick substrate, however, retain the abundant invertebrate community and over the years may develop a highly diverse invertebrate community.

Biodiverse roofs show an exactly opposite trend to thin substrate *Sedum* roofs. Invertebrate colonisation is extremely slow at the beginning, as these sites experience retarded succession. However, over the years invertebrate abundance as well as diversity builds up and they support an abundant invertebrate community. These communities tend to be much more diverse than on *Sedum* roofs. Biodiverse roofs as a result of their low nutrient well-drained substrate develop a herb rich and diverse plant community, while on *Sedum* mats the plant diversity and architecture is low. As most invertebrates respond not only to the plant species but also to architectural diversity of plants, biodiverse roofs provide an excellent habitat for many invertebrates.

4. Most important features affecting Green Roof design

(i) Substrate

Substrate is the most crucial element in green roof design. The properties of substrate, such as depth, nutrient content, and particle size greatly influence the actual structure and overall diversity of the habitat.

The type of substrate used on roofs may vary from site to site, but principally it should be a nutrient poor well-drained growing medium. A nutrient poor soil promotes diversity by slowing colonisation and reducing the dominance of certain species (such as grasses) that thrive in nutrient-rich conditions. Too much organic content may reduce plant and faunistic diversity as in nutrient rich soil, grass species out-compete herbs. The use of crushed brick and concrete, gravel and sand mixes provide a good growing medium on green roof habitats. In principle the use of recycled secondary aggregates should be encouraged. The use of other aggregates should be considered in specific areas to meet specific habitat conditions, such as shingle on the south coast to mimic vegetated shingle.



Laban Dance Centre has a Biodiverse roof, designed primarily for biodiversity. The substrate is crushed demolition waste from site, applied on the roof. The substrate varies between 300-700mm and sown with wildflower seeds collected from surrounding brown-field sites.

(ii) Structural diversity

Structural diversity provided on a roof can create a mosaic of habitat types and microclimate, which will be favoured by a wide range of species. Structural diversity can be created by using substrates at different depths where longer vegetation can develop. This creates a varied topography and allow a diverse vegetation and animal community to colonise.

The addition of dead wood provides a cooler damper microhabitat, as well as a habitat for burrowing, nesting and feeding for certain species. Elements such as A-frame solar panels [both solar thermal and photovoltaic] on the roof also add to the topographical diversity of the habitat, as they provide shade, with damper and wetter areas as a result of the rainwater accumulating at the base of the panels. Undulation or shady areas of the roofs create damper or wetter areas, even ditches and puddles which provide extra elements to the habitat diversity.

It was evident from the study that there is no one design which would fit all; different substrates at varied depth may do better depending on the season and successional stages of the roof. Consequently it is a diversity of substrate and depth that will maximise the overall diversity of a roof habitat and provide the most value for urban conservation.



Komodo Dragon House, London Zoo



Somas Centre, Tower Hamlet

5. Recommended guidelines for green roof design

To maximize biodiversity potential of green roofs, the following criteria are recommended:

Type of green roof: Extensive brown/biodiverse roof

Substrate: Low nutrient based aggregate substrate with 10% organic matter. The substrate depth should be varied between 50-150 mm depth to provide small mounds. Smaller areas of different substrates such as sand and shingle should also be provided to create a habitat mosaic.

Structural diversity: Provided by varying the depth of different substrates. Substrate diversity could be increased with additional features such as large boulders and logs.

Plants: The roof should be sown with a herb mix (appropriate to the regional locality), which contains both annual and perennial species. Grasses should be excluded from the seed mix, as they would colonise naturally. Seeds should ideally be collected from local sites.

Management: Extensive green roofs should be maintenance free. However the removal of *Buddleia* is advisable.

The above guideline is suitable to create roof habitats and mitigation sites for lost brownfield land in London and the East Thames Gateway area. However, if roof habitat is to be created in other parts of the UK the use of local substrate should be considered.

Published Work

Rare Invertebrates Colonizing Green Roofs in London by Dr. Gyongyver Kadas

http://www.urbanhabitats.org/v04n01/invertebrates_full.html

Green roofs and biodiversity by Dr Gyongyver Kadas and D.Gedge

Volume 52 Number 3, July 2005 Biologist [Institute of Biology]

www.iob.org/userfiles/File/biologist_archive/Biol_52_3_Kadas.pdf

Future Work

The research is continuing through a number of projects that have developed out of the PhD study.

In 2009, 6 biodiverse roofs will be installed across London as part of the Buglife Sita Nature Enhanced Project. The roofs will be designed following the guidelines above and monitored for a three year period. The study has led to interest in adapted existing sedum to increase their diversity. In 2009 innovative adaptations using flower rich hay faggots and substrate mounds will be installed on two large sedum blanket roofs in London, one in the City and one in the Canary Wharf area. This work will be undertaken by Dr. Kadas and D. Gedge on behalf of the The **Green Roof Consultancy**. Images and the processes should be available later in the year on Livingroofs.org.

Sponsors:-



For further information:

www.livingroofs.org

