Measuring Biodiversity on Green Roofing in London

Introduction

A larger proportion of an increasing global population is expected to live in an urban setting by 2050 – in the UK alone this could be around 90% of the population (United Nations, 2017). It is accepted that urbanisation can have detrimental effects on biodiversity – mainly from habitat loss and fragmentation causing decreased population numbers of both fauna and flora species, as well as the hinderance of gene flow essential for resilience (Coulon et al., 2004; Wang et al., 2018). Innovative and sustainable urban design can benefit biodiversity and provide a variety of ecosystem services beneficial to human health and well-being, such as decreased air and noise pollution, and insulation (Sirakaya, 2018; Shafique et al., 2018; Marselle et al., 2021).

Green roofing is a relatively new concept: the first green roof in London appeared in the early 2000's. The Greater London Authority Living Roof Report (2019) provides a clear definition of the types of green roofing that exist and is used for the purpose of this research –

a) **Intensive green roofs** - including mainly roof gardens
b) **Extensive green roofs** - planted mainly with Sedum species cover
c) **Extensive biodiverse green roofs** - either seeded with a bespoke native wildflower mix or left to self-colonise as in the case of brown roofs.

A recent literature review by Wang et al. (2022) concluded that there is little research and empirical data on the ecological function and biodiversity of green roofing in situ, especially over time. This was especially true when comparing the roofs to adjacent ground level habitats. Several factors have been suggested to influence green roof biodiversity e.g. building height, roof age, substrate, shading and human management. Research to date suggests substrate depth, drought occurrence, substrate composition and surrounding green space are main factors (Van der Kolk et al., 2020; Vandegrift et al., 2019; Bates et al., 2013; Bates et al., 2015; Vergnes et al., 2017).

Further attention is warranted if green roofs are to maximise their potential to provide biodiversity in the built environment and inform design and maintenance of sustainable buildings and infrastructure. This is essential if green roofing is to be used as mitigation for habitat loss at ground level and to inform Biodiversity Net Gain Legislation coming into effect in the UK in 2023 – where new buildings are required to provide a 10% addition in biodiversity.

Green Roof Project in London

In London, green roofing has increased significantly since policy change from the London Mayor's Office in 2008 (Greater London Authority, 2008). In 2010 they covered approximately 715,000m^2, doubling to 1,510,000m^2 by 2017. At that date there were over 30 extensive biodiverse roofs ranging in area from 38.37m^2 to 1903.54m^2, an increasing trend observed around the world.

A total of twelve sites were recruited in central and greater London for the project:

Four extensive biodiverse roofs

Two sedum roofs with conversion measures for biodiversity

Three sedum roofs

One brown roof

Two adjacent ground level sites – one near an extensive biodiverse roof and one near to the brown roof

The sites were surveyed in May and June 2023 to gather data on the plant communities found, substrate depth and height (floor level used as proxy). In addition, data was collated on roof age and size and in the case of extensive biodiverse roofing, the initial seed mix used when the roof was constructed.

Figure 1. Eleventh Floor Sedum Conversion Roof in the City of London – Nomura International Plc.

Roofs and Adjacent Habitats in The Project

Roof	Type	Age (years)	Substrate Depth (mm)
A Greenwich1	Extensive biodiverse	10	80 - 110
B Greenwich2	Extensive biodiverse	10	70 - 110
C Hackney Sports	Extensive biodiverse	13	120-160
D Greenwich3	Extensive biodiverse	10	75-105
E Nomura	Sedum conversion (2019)	13	70-140
F Grosvenor	Sedum conversion	10	75-95
G Greenwich4	Sedum	10	55-110
H Davies Street	Sedum	10	70 -78
I Greenwich5	Sedum	10	85-115
J Trinity Laban	Brown	20	55 - >200
K Hackney Tree	Unimproved grassland	------	>200
L Creekside	Brownfield	------	>200

Early Results

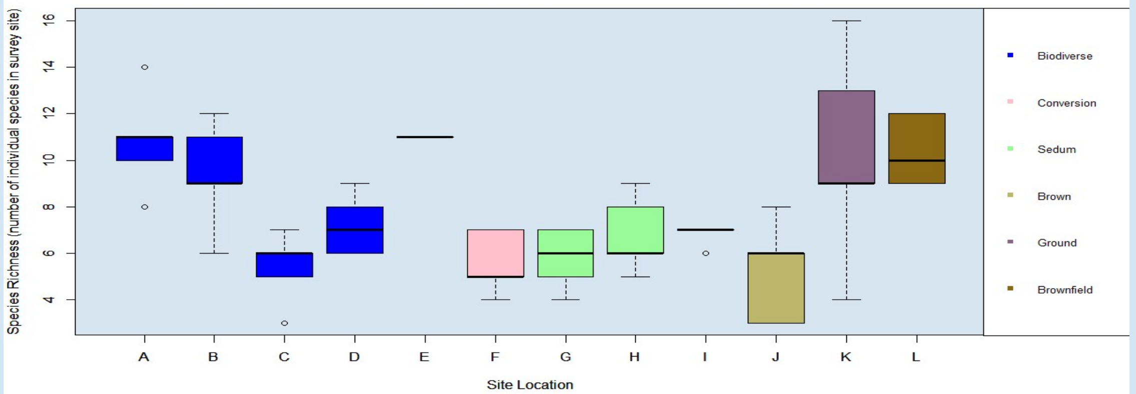

Figure 2. **Species Richness across the twelve sites**. An ANOVA was performed between extensive biodiverse sites A, B, C and D showing significant difference in species richness between site A with sites C (t=-0.46, df=16, p=<0.001) and D (t=-3.04, df=16, p=0.008) but not with site B (t=-1.18, df=16, p=0.254).

Method

Vegetation was surveyed at each site using a stratified random sampling technique by placing a total of five 1 x 1m quadrats, placed at equal distance diagonally across each roof. In the case of one roof, although rectangular, the roof composed of separate distinct sections – consequently a quadrat was used in each area. All plant species found in each quadrat were recorded as well as percentage coverage and individual plant numbers for forbs (exception of sedum species). A measure of substrate depth in mm was taken for each quadrat.

Some Challenges

Figure 3. Safety harness required.

Figure 4. 'Beauty and the Beast!' Wildflowers around a 'stink pipe' on an extensive biodiverse roof.

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Invertebrate Assessments

The initial intention was to make a broad assessment of pollinator activity on the survey days by carrying out standardised Flower-Insect Timed Counts and sweep netting. However, it became apparent that due to the very high temperatures on the roofs and time constraints this was not viable. Instead, four yellow pan traps and four pitfall traps were sited and left for four days on each roof. Identification of specimens is ongoing.

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