URBAN HABITATS FOR GROUND-NESTING BIRDS, INSECTS AND PLANTS

GREEN ROOFS IN SWITZERLAND

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Global warming is becoming an acquired fact. There is the impression that the main result of change of climate is the increase of temperature; but in reality the main effects of global warming will be and are already felt worldwide.

Up to 75% of urban zones of many cities across the world are covered with permeable and warm absorptive (and highly reflective) surfaces (asphalt, concrete), and roofs represent a big part of this (Dunnett, 2007). This means that 75% of normal rains will not be absorbed in the soil, ground waters and runoffs, through drainage systems, into the rivers. The lack of vegetation in urban zones means that the following important functions in the cycle of water, absorption and retention, which are assured by the vegetation and open soils (and rooftop substrates) are missing.

By returning directly to the 75% of permeable surfaces in urban zones, when the same surface is planted, thanks to the vegetated roofs and living vegetated walls, up to 90% of the rain is progressively absorbed by the soil and will reduce flash flooding. Various plants and animals worldwide are threatened by habitat loss and fragmentation due to increasing urbanisation. Extensive green roofs can provide suitable habitats for animal and plant species that are able to adapt to difficult conditions and develop survival strategies for extreme local conditions and mobile enough to reach habitats on roofs (Brenneisen, 2003).

Green roof activities and research in Switzerland have focused for many years on ecological compensation, the potential of habitat creation on roof surfaces, to compensate for the loss of habitats that are destroyed or damaged on the ground as a result of development (Baumann, 2008). The living space on a roof is primarily stamped by limited water supply, and this leads to the development of green roofs, similar to those found in natural dry regions and habitats, to desert or steppe-like vegetation. These habitats include: riverbank and flood plains with gravel and sand, which are important for bird species that favour gravelly river terraces or open meadows. Post-industrial brown field sites, which are ecologically rich, particularly for their invertebrate flora and interesting spontaneous plant communities, and abandoned railway sites, are also important for specialised flora and fauna, such as, species living on stony open surfaces with a thin soil layer.

The creation and designing of lost habitats on extensive flat roofs in Switzerland is called: “natural roof”. This term shows that there is more that takes place when greening a roof and that the whole ecological entity of the habitat and its different species are considered.

DESIGNING AND CREATING NATURAL ROOFS

Greening roofs closes an ecological circle and offers nature and the environment protection in urban zones with a new chance to improve biodiversity. The planning of the ecological effect of a natural roof must consider the specific location in terms of the exposed living space at planning phase: the concept, design and installation. It is essential to connect the oriented aim of the basic ecological principles and the substrate qualities with the building or constructional aspects. Two main principles underpin this work. Firstly, local soils and substrates are used. For example, topsoils, subsoils, or urban secondary materials, such as rubble that cover brown field sites, can be used. In all cases, it is recommended that the top 15 centimetre (6 inches) of material from construction sites is removed and carefully stored so that some existing vegetation, seed bank and soil organisms can be preserved in order to support locally appropriate plant and animal communities (Brenneisen, 2006). Secondly, seed mixtures of vegetation types typical of the area are used (indigenous) and roofs are encouraged to colonise spontaneously with vegetation.

Designing and creating a natural roof means also considering and determining what kind of habitat is going to be installed. The appearance of the vegetation that is aimed towards has to be brought in and connect with the corresponding substrate choice in type and thickness, such as in the cases of a poor species (flora and fauna) habitat with a homogenous appearance, or a habitat with diverse species and design, and therefore with a higher maintenance for nature conservation. The appearance and the biodiversity of natural roof are steered by the structure and the application of different added substrates types.

More rainwater is needed to be stored in the middle and thin-sized pores in a substrate, that means medium-term usage for plants and animals with more biomass can develop on a roof (from Moos/ Sedum to meadow vegetation).

The natural roof is a modeled or specially designed landscaped surface with different substrates (topsoil, gravel, sand, recycled soils, etc.), structures (piles of dead wood - branches and trunks, stones, etc.) and topographies. Different substrate thickness, surface-like distribution with layers of 6, 8, 10, 15 and 20 centimetres (2, 3, 4, 6 and 8 inches) and topography like small hills to 30 centimetres (12 inches) thickness, and a diameter of 2 – 3 metres (6.5 – 10 feet) “retreat” for soil invertebrates and spider-scan be furnished in statistically favourable places above supporting walls or other weight-bearing parts.

VEGETATION AND PLANTS

The water retention capacity of the substrate on the roof determines the developing vegetation type: the higher the water retention, the denser and higher the growth of plants. The planning of a green roof needs to consider the regional precipitation ratio. In a region with average precipitations, you will get upward of 10 centimetres (4 inches) substrate thickness meadow-like vegetation in three to five years. Increased substrate depth enables greater diversity in planting, for example, mixed vegetation including grasses, thymus, lavender, alliums, etc., growing on 10 centimetres of growing medium. On very thin depths of substrate, only a limited range of plants are suitable, such as these sedum-dominated (sparse growth) roofs on 4 – 7 centimetres (1.5 – 2.75 inches.) growing medium substrates, with coarse pores and therefore low water retentions. There are differ-

ent application methods for plants used and tested on the different research sites in Switzerland: seeding, planting annuals and perennials and hay mulching (bundled cut grass of dry meadows).

First, results show that when mixing up these methods, also applied on different surfaces on the roof according to the topography and substrate type, the flowering season will be extended because of different vegetation types and as the roofs are not watered during harsh dry seasons, some plants endure better dry periods and others dry out (Baumann, 2008). The establishment of hay mulch, for example, showed a well and fast success, as it is not blown away by windy conditions on the rooftops. Important to consider with this method is that the applied layer thickness plays a role in germination processes. Another positive aspect of this method is that from the installation, there will already be a certain amount of biomass on the top of substrate which helps to retain rainwater and also keeps it humid for a while during dry seasons (Baumann, 2008).

INSECTS

The diversity of insects and spiders on natural roofs in Switzerland has been studied for more than 15 years. Studies in Basel examined 17 green roofs (including turf, sedum, brown roofs and specially designed roofs with local waste material substrates), where two groups of invertebrates (good indicators of vegetation structure) were monitored: ground beetles and spiders. This also included small-scale research on wild bees (solitaire bees), butterflies, grasshoppers and cicada, where in the first three years of this research programme, 78 spider and 254 beetle species were found (Brenneisen, 2003). 14 (18%) of the spider species and 27 (11%) of the beetle species were classified as rare or endangered (Dunnett, 2008). Important findings of this study were: a) older green roofs tended to support more species than younger ones, b) thin layers of substrate that dry out very quickly are less valuable than those with thicker substrate depths and c) total plant species-richness is a key factor in promoting invertebrate diversity.

BIRDS IN GENERAL AND GROUND-NESTING BIRDS

Another research topic in Switzerland explores bird activities, feeding and nesting on green roofs. Several bird species in Switzerland are threatened by habitat loss and fragmentation, due to increasing urbanisation (Baumann, 2006). Birds use green roofs in cities mostly as feeding habitats and the search for nesting materials. The most frequently recorded species were black redstarts (*Phoenicurus ochruros*), wagtails (*Motacilla* species), rock doves (*Columba livia*) and house sparrows (*Passer domesticus*) - all species are naturally occurring in open landscapes, such as higher mountain areas, river banks, or in steppes with grasslands, bare stony ground and patchy vegetated areas (Dunnett, 2008).

Five years of research has been carried out on the nesting activities of this ground-nesting birds: northern lapwing (*Vanellus vanellus*), little ringed plover (*Charadrius dubius*) and eurasian skylark (*Alauda arvensis*) - all are classified on the Swiss Red List as endangered species and have high protection priority in European biodiversity programmes. On six roof sites in mainly industrial zones in peripheral urban and rural areas, long-term and intensive observation of northern lapwings breeding have successfully bred chicks until they fledged; both the behaviours of the adult birds and chicks were and are still observed and analysed. Chicks of most of the ground-nesting bird species are parochial; they must find food and water for themselves from the first day they hatch. The type of vegetation found on these roofs was varied: from Moos/ Sedum-Type roofs (with thin substrate depths and purely mineral: coarse pores) to graveled roofs. All of these roofs were improved with a small amount of added substrate vegetation (light compost soil) surfaces (hay mulch and seeding methods - good for light weight roofs) on top of the initial substrate. These newly vegetated surfaces developed very well.

Since 2008 to the present day, three of the six sites supported two to five young birds of two to three different families, which have survived and fledged every year. Also, the average age of the chicks, from 4 to 5 days in the first year in 2005, increased to 28 to 32 days (the chicks fledged after 40 days) in 2010. This success is due to the well-established added vegetation that is attracting invertebrate diversity (developing life cycles on the roofs: larvae, caterpillars, etc.), which is the food base of the chicks.

GREEN ROOFS – AN ECOLOGICAL COMPENSATION SURFACE

These research results show it is possible to design natural roofs as a biodiverse habitat with different and various species, supporting endangered and rare species. Mixed planting of perennials, annuals, grasses, etc. ensures that the variety and flowering season lasts from spring till autumn. This gives a welcome and beautiful variety in textures that improves over a longer period of time with insect diversity.

Design guidelines and norms in Switzerland for designing natural roofs are and were partially developed for councils, planners, architects, builders, city, community, county and federal authorities. These are needed to support the green and natural roofs as ecological compensation surfaces that promote and support biodiversity and valuate wildlife (habitat), mitigate urban climate, manage storm water, filter pollution, save energy costs, have aesthetic improvements and extend the life of a roof. It is already possible and affordable to design an ecologically valuable green roof.

References:

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