



Natural England works for people, places and nature to conserve and enhance biodiversity, landscapes and wildlife in rural, urban, coastal and marine areas. We conserve and enhance the natural environment for its intrinsic value, the wellbeing and enjoyment of people, and the economic prosperity it brings.

www.naturalengland.org.uk

© Natural England 2007

ISBN 978-1-84754-016-4

Catalogue code NE30

Written by Dusty Gedge, with Nigel Dunnet, Gary Grant and Richard Jones

Designed by RR Donnelley

Front cover image: Additional supports allow this shed to bear the weight of a semi-extensive roof. Nigel Dunnet

Living roofs

www.naturalengland.org.uk

NATURAL
ENGLAND

NATURAL
ENGLAND

Living roofs

If you can see any roofs from your house or office, the chances are that they are fairly lifeless and unappealing – perhaps made of bitumen or asphalt. But roofs don't have to be dull and dead. With effort and imagination, we could change these sterile surfaces into green oases. These would not only provide a haven for wildlife but also transform the view from upstairs windows!



Even Portakabins can be given living roofs.
ZinCo GmbH

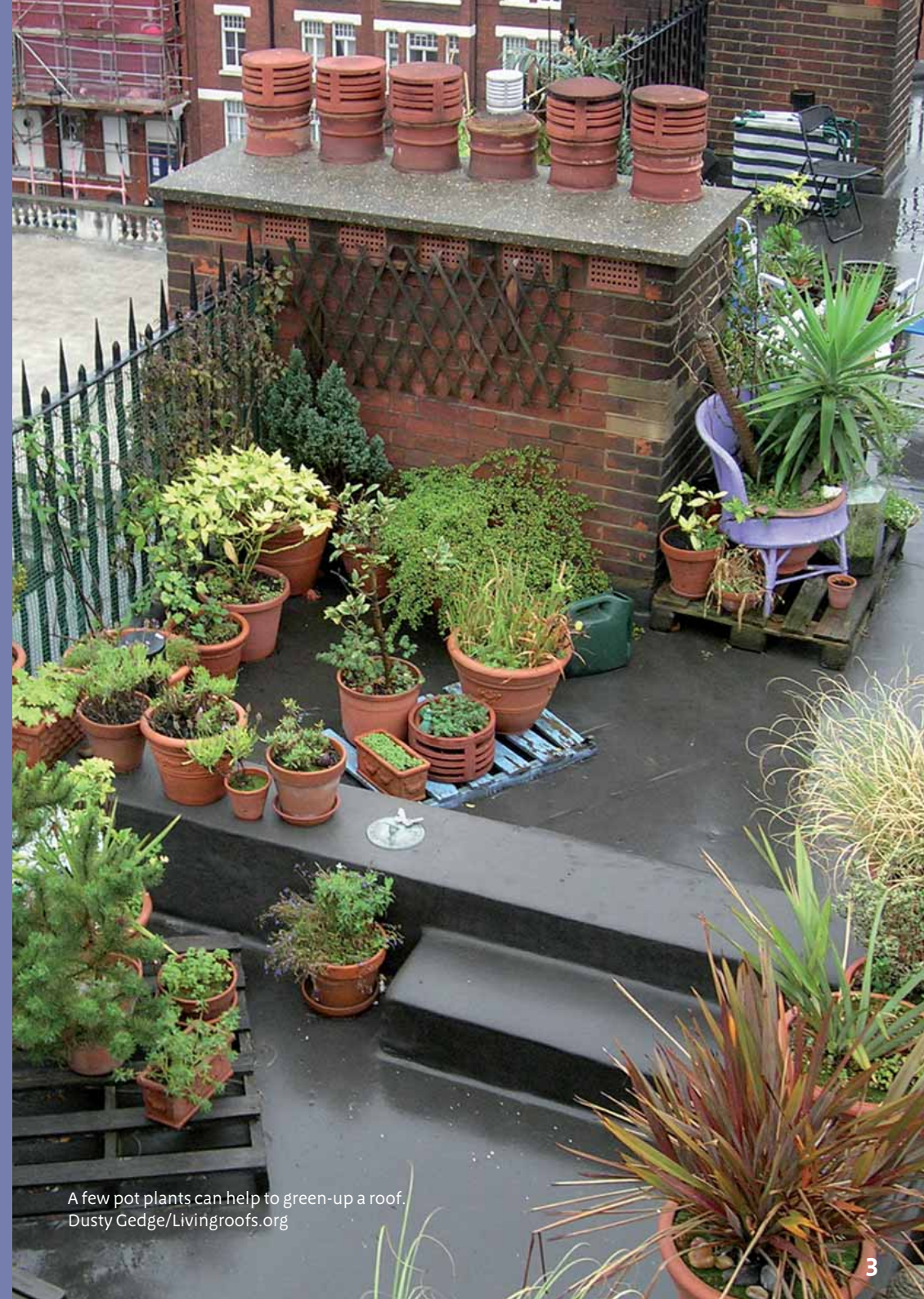
Some greenery will naturally grow on most roofs. Many roofs are home to some very rare moss and lichen species, especially in areas of low pollution. However, in this booklet the term 'living roof' (or 'green roof') is used to describe a roof that has been intentionally covered in vegetation. These are now very common in countries such as Germany and Switzerland, where they can be found

on all sorts of buildings, from factories, hospitals and schools to offices and housing developments. But it's not just large buildings that are suitable for this treatment: there are many opportunities to create living roofs on and around the house and garden – on sheds, porches, outhouses, balconies, garages and small extensions. Even in the inner city, the roofs on housing estates, multiple garages, litterbin sheds and balconies all have the potential to be greened.

The plants suitable for living roofs are not necessarily those found in a traditional English garden, but they can help create habitats that will attract some very interesting and unusual wildlife.



A living roof on a Norwegian boathouse.
Roger Key/Natural England



A few pot plants can help to green-up a roof.
Dusty Gedge/Livingroofs.org



A living roof in Canary Wharf.
Dusty Gedge/Livingroofs.org

This leaflet provides some guidance on how you can make a living roof. However, it is only an outline and cannot take the place of expert advice from relevant professionals such as structural engineers, roofing contractors and suppliers.

The case for living roofs

Living roofs are not just good for wildlife: they make a positive contribution to the environment in a number of other ways.

- They help to cool the room below in hot weather. Conversely, in winter a living roof can provide insulation.
- Living roofs act as sponges, retaining water before allowing it to evaporate into the atmosphere. In heavy rainfall, this can reduce the likelihood of local floods and this is one of the main reasons living roofs

are now a legal requirement in Germany.

- They protect a roof's waterproofing from the effects of ultra-violet light and the weather, especially frost. This means that the roof is less likely to leak.

Types of living roof

Living roofs can vary greatly in their appearance and character. They can be designed to support low-growing mosses and sedums, wildflowers and grasses and even shrubs and trees. Everything depends on the type of roof in question. There are three basic types: extensive, semi-extensive (also known as semi-intensive), and intensive. These terms relate to:

- the amount and kind of maintenance that each type may require;
- the depth of soil (more usually referred to as 'growing medium' or 'substrate') which may either be natural or manufactured; and
- the type of plants the area will support.

Extensive (shallow) living roofs

These are the most lightweight and easily-maintained living roofs and are therefore also the most common. They are made using shallow soils, which often dry out. This factor, combined with wind and frost exposure, creates a very harsh environment for plants. To cope with these conditions, any plant

living here needs to be tough, hardy and drought tolerant. These are generally species that, in the wild, grow in coastal, cliff, mountain and dry meadow habitats.

Extensive living roofs tend to have a relatively low weight and are thus the most suitable choice for structures such as sheds, garages and small extensions.

Advantages:

- Light weight: 80 – 120 kg/m².
- Shallow soils: depths between 20 mm and 100 mm.
- Can withstand harsh weather conditions (especially lack of water).

- The conditions are good for a range of drought-tolerant species often under pressure in the wild.
- Very low maintenance.

Disadvantages:

- The most lightweight and shallow living roofs will support only a small range of vegetation.
- Simple living roofs may have limited visual appeal.
- Shallow, extensive living roofs can be very susceptible to severe drought, leading to die back and patchiness.

Additional supports allow this shed to bear the weight of a semi-extensive roof. Nigel Dunnet



Semi-extensive (deep) living roofs

Also known as ‘semi-intensive’, these roofs have deeper soils and can support both a greater number and a wider diversity of plants, making them more decorative. However, their depth makes them heavy and they need a relatively strong structure to support them. Semi-extensive living roofs combine some of the low-maintenance and low-input benefits of extensive roofs – especially if naturalistic plantings are used. Some types, though, are effectively small gardens in their own right and need to be tended in the same way, including regular weeding and watering.



Before and after. A living roof can brighten up the duller space. Georgina Cape

Advantages:

- Can support a wider range of plants and other associated wildlife.
- More decorative than extensive roofs – have a longer flowering season.
- Require less water and other inputs, such as fertilisers.

Disadvantages:

- Need a strong structure to support them.
- Additional maintenance is required – the greater depth of substrate also encourages unwanted plants to grow there.

Living roof type	Soil or substrate depth	Planting possibilities
Extensive	0–5 cm	Simple sedum/moss communities.
	5–10 cm	Short wildflower meadows. Low-growing, drought-tolerant perennials, grasses and alpine, small bulbs.
Semi-extensive	10–20 cm	Mixtures of low or medium perennials, grasses, bulbs and annuals from dry habitats. Wildflower meadows. Hardy sub-shrubs.

Intensive (very deep) living roofs

Intensive living roofs are a third distinct type, but not one considered here. These roofs have very deep substrates, allowing the growth of lawns, shrubs and even trees. They are therefore impracticable in almost all domestic situations.

Which roofs are suitable?

Flat roofs lend themselves most readily to being ‘greened’. It is also possible to green other types such as pitched, barrel and domed roofs. In these cases, however, restraints are needed to ensure that the growing medium does not slide off. Roofs with very steep slopes are clearly not suitable!

Garages

Garages with tiled or corrugated roofing may not be able to have a full living roof. The structure may need to be assessed. However, encouraging moss on the roof will provide habitats for invertebrates and feeding areas for birds such as blackbirds.

Garages with flat asphalt roofs should be able to support a lightweight living roof such as a sedum blanket or, if a concrete deck has been used, a deeper substrate-based extensive living roof that can be used to grow wildflowers.

Sheds

As sheds are generally very lightweight structures, even putting on a sedum blanket may be inadvisable without



A living roof prior to planting and seeding. Dusty Gedge/Livingroofs.org



Sedum mat on the roof of an extension. Jeremy Linden

some structural strengthening. However, it is easy to encourage moss to grow on sheds.

It is often reasonably easy to provide added structural support to a commercial shed, so allowing a heavier, wildflower-rich living roof to be installed.

Extensions, outhouses and balconies

It should be possible to install living roofs on small extensions, outhouses and balconies. Again, whether a sedum mat system or a heavier substrate-based system is used will depend on the structure below.

Building a living roof – the basics

While the exact choice of the type of living roof to be used will depend on the strength of the individual building concerned, it is always vital to ensure the following:

- The existing waterproofing is sound and does not leak. It may be advisable to renew the roofing layer before any installation takes place.
- The structure of the building to be converted is sound and can take the load.

The need to take expert advice on these two essential matters cannot be over-emphasised.

If you're planning to put a living roof on your shed, there are some important points to bear in mind:

- Collapsing sheds are expensive and dangerous! Please don't try to create a living roof on your shed if you have any doubts about its ability to support one.
- Only build a living roof on a new or relatively well preserved shed that is on solid, level foundations.
- If necessary, strengthen your shed internally with timber braces between the uprights. Deeper, heavier roofs might need additional exterior supports.
- Although unlikely, be alert to the danger of the new roof compressing the shed glazing and perhaps breaking it.
- Try to keep the amount of roof substrate to a minimum and reduce its weight by bulking it out with expanded clay pellets.
- After constructing your living roof, thoroughly soak the substrate with water and look for signs of instability.
- After making a living roof, monitor the condition of your shed regularly, especially after heavy rain or strong winds.

How to do it

In some cases the cost of specialist living roof products may exceed the original cost of the building itself. However, it is possible to put together a small-scale living roof using materials available in most garden centres and hardware shops. It is possible to encourage mosses and lichens to grow on a lightweight building without much work or expense. However, if a roof is to support flowering plants, it requires a series of layers.

The basic elements of any living roof system are these:

- **Waterproof layer.** The base layer. Added to the existing surface, this will give greater security and peace of mind even if the roof is already soundly waterproof.
- **Root membrane.** Waterproofing layers, such as asphalt and bitumen, are very susceptible to damage from plant roots and any root penetration may lead to leaks. A pond liner, butyl lining or 300 micron damp-proof polythene should be laid over



Filter sheet. Dusty Gedge/livingroofs.org



Drainage layer. Dusty Gedge/Livingroofs.org

the waterproof layer and, wherever possible, in one continuous sheet. Otherwise, the sheets should overlap by at least 20 cm.

- **Filter sheet.** This sheet allows water to drain off the roof but stops the escape of fine materials in the substrate.
- **Moisture blanket.** For extensive living roofs, this blanket will ensure that the growing medium (the soil or



A mini living roof! Dusty Gedge/Livingroofs.org

substrate) retains enough moisture to support life. Commercial ones can be bought which do not degrade but it is possible to use cardboard or old blankets to achieve the same effect.

- **Drainage layer.** Like the moisture blanket, this helps to retain moisture while allowing excess water to drain away. Commercial systems store water and are made of plastic or geotextile materials.
- **Soils and substrates.** The top layer. The growing medium should be lightweight and free-draining yet of a material that retains moisture. Many people use aggregates mixed with light sub-soils such as crushed porous brick and limestone chippings.
- **Seeds and plants.** Sow seeds on the substrate, or put in plug plants (small plants in individual cells) and watch them grow!



Well-drained substrate.
Dusty Gedge/Livingroofs.org

Plants and living roofs

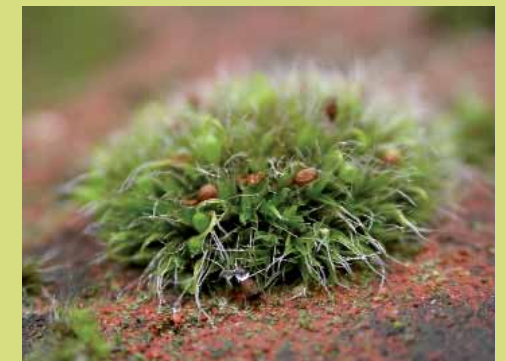
Mosses and lichens

The lightest living roofs – and the simplest to create – are those supporting mosses and lichens. Mosses are a group of small green plants that do not flower or fruit but produce spores. They require such small amounts of nutrients that many species are able to live in inhospitable places, clinging to walls and stone and tiles waiting for rain. The 'moss forest' provides cover for thousands of microscopic animals, such as water bears (Tardigrades), and a habitat for other invertebrates which, in turn, are food for birds. Moss on buildings is often – and unfairly – associated with neglect, but it can bring many of the benefits of a living roof, such as shielding the roof from ultra-violet light, absorbing water and cooling.

Lichens are composite, symbiotic organisms made up of fungi (which dominate) and algae or cyanobacteria. Food manufactured by the vegetative element of the organism through photosynthesis is enjoyed by the host fungus. As a result, lichens are able to survive extremes of temperature and drought and can colonise surfaces too sterile for most other organisms (including metal, glass and plastic).

Look closely and you will see that these anciently-evolved plants adorn even the most urban environment. Walls often support the grey cushions of the moss *Grimmia pulvinata* or the

conspicuous yellow seta (stalk-like structures) of wall screw-moss *Tortula muralis*. Where there is enough moisture, carpet-forming mosses like rough-stalked feather-moss *Brachythecium rutabulum* may be found. That yellow crust you can see on many tiled roofs is *Xanthoria* lichen. Although it is possible to encourage or cultivate lichens and mosses, patience is required because these are relatively slow-growing organisms. Some lichens, for example, may grow less than a millimetre a year! There is a centuries-old tradition of growing moss gardens in Japan. Self-established moss carpets



Top: Wall screw-moss *Tortula muralis*.
Bottom: The moss *Grimmia pulvinata* forms attractive cushions. Ron Porley/Natural England



Biting stonecrop *Sedum acre* thrives on well-drained ground and has spectacular flowers.
Roger Key/Natural England

can be encouraged on a layer of sandy soil 20 mm deep or less and, if kept damp, moss communities will establish themselves here through airborne spores. If you can find moss which has been stripped from a building (by those who do not appreciate it!) you can replant these sods on your own roof. Even if planted sods fail, they will encourage the colonisation of other, better-suited mosses. It's worth noting that various species of moss will flourish on the sedum-type living roofs discussed below. A number of companies specialise in providing pre-grown moss mats and other means of speeding up moss growth.

Sedum roofs

Sedums are the most widely-used plants for living roofs as they have many advantages in terms of hardiness and drought tolerance. Being



Bumblebees enjoying sedum on a roof.
Nigel Dunnet

succulents, they actively store water in their tissues and have a number of ways of reducing their need for water in dry weather.

Under conditions of severe stress many sedums change colour from green through to red, purple and brown. Although they are very tough, you must remember that sedums growing on very thin substrates, or on simple moisture mats, may die back and become patchy during periods of extreme dryness.

Commonly-used species on living roofs include white stonecrop *Sedum album*, *S. hispanicum* and *S. reflexum*. These

species are not native, however, so for preference use biting stonecrop *Sedum acre*, a relatively common native of rock outcrops and old walls. All sedums are evergreen and most low-growing species flower for a relatively short period in midsummer. White stonecrop and biting stonecrop have some of the most spectacular flowering displays and are very attractive to bees, butterflies and other insects.

There are three main ways to establish a sedum roof.

- **Seeding.** Although this is the cheapest option it will take time for the plants to fully cover the area.



Grasshopper on *Sedum album*. Native sedum species are preferred, however.
Dusty Gedge/Livingroofs.org



A living roof planted with wildflowers.
Dusty Gedge/Livingroofs.org

- **Cuttings or plugs.** Place plants across the roof area.
- **Commercial pre-grown sedum blankets.** These can be rolled out on to the surface of the roof or the growing medium. A few companies now supply these mats ready-impregnated with wildflower seeds to increase the diversity of plant species.



Many species appreciate dry grassland as a habitat.
Mathew Frith

Wildflower roofs

The conditions on a living roof (free-draining substrates with low fertility) are ideal for the creation of highly diverse and species-rich grassland plant communities. More often than not, these dry grassland 'roof meadows' are more successful than those that people try to grow in their gardens.

Rooftop meadows have a number of advantages:

- A diversity of flowering plant species will result in a longer overall flowering season, thereby extending the period during which the roof flora acts as a nectar source for insects. Late-flowering species are particularly useful in this respect.

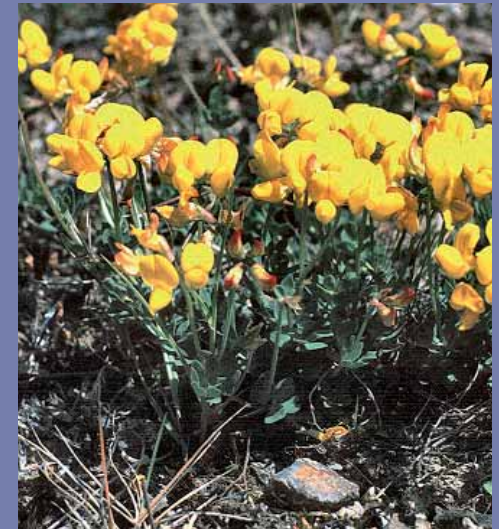
- If the meadow is left uncut throughout autumn and winter, the standing seed-heads will provide food sources for seed-eating birds, and the dried-out stems and stalks will provide over-wintering shelter for a range of invertebrates.
- Living roofs can support local or regional plant communities and vegetation types that might be endangered in the wild.

Calcareous grassland living roofs

The use of limestone chippings and mixtures of crushed brick and concrete will allow a calcareous meadow to develop. Such meadows are very species-rich and can still be found in the wild on steep slopes and the remnants of unploughed pasture. The soils on these habitats are thin, typically between 50 mm and 100 mm – the same sort of depth as that on an extensive living roof. In the wild, these grasslands can support as many as 30 to 40 species per square metre, so even a small living roof will, potentially, be home to many different plants.

Where living roof substrate depths are relatively shallow (50–100 mm) low-growing and creeping species such as the following may be planted.

Bird's-foot-trefoil *Lotus corniculatus*
Cowslip *Primula veris*
Harebell *Campanula rotundifolia*
Hawkweeds *Hieracium* spp
Horseshoe vetch *Hippocrepis comosa*
Kidney vetch *Anthyllis vulneraria*
Lady's bedstraw *Galium verum*



The distinctive yellow flowers of common bird's-foot-trefoil *Lotus corniculatus*.
Roger Key/Natural England

Common rock-rose *Helianthemum nummularium*
Salad burnet *Sanguisorba minor*
Small scabious *Scabiosa columbaria*
Thyme *Thymus polytrichus*

At greater depths (100–150 mm) these plants are suitable:

Field scabious *Knautia arvensis*
Greater knapweed *Centaurea scabiosa*
Wild marjoram *Origanum vulgare*
Viper's bugloss *Echium vulgare*

It is better not to seed a living roof with grasses as they may out-compete wildflowers. Many wildflowers will colonise your roof naturally but it is worth adding seeds of wildflower annuals as they provide an early burst of colour and many are becoming very scarce in the UK. Examples include scarlet pimpernel *Anagallis arvensis*,



Cornflower *Centaurea cyanus*.
Peter Wakely/Natural England

cornflower *Centaurea cyanus*, corn marigold *Chrysanthemum segetum*, corncockle *Agrostemma githago*, wild pansy *Viola tricolor* and scentless mayweed *Tripleurospermum inodorum*.

Establishing rooftop wildflower meadows

Wildflower meadows can be established in a number of ways. Seeding is the most cost-effective method. Mixing the seed with a quantity of sand prior to sowing allows a more even spreading of seed across the surface. If you are sowing on to a sloping roof it can be beneficial to tack an open hessian or jute mat over the sown mix to protect the soil from heavy rain.

Wildflower plants can also be established using plugs or small pot grown plants. This is more costly, but gives you greater control over the composition of the roof flora. A combination of seeding and planting can also be effective. Both seeding and

planting are best done in the autumn and spring. Dry summer weather should always be avoided.

Maintenance

Most people want a living roof that is low on maintenance. As with all other types of garden and landscape, the amount of work needed will depend on the intended outcome! If a perfect, manicured green space is what's required then the area will need a lot of attention. However, extensive living roofs need relatively little maintenance. Semi-extensive areas will need more attention to keep them looking good and to maintain their diversity of species.

Sedum roofs

If a pristine green carpet of sedums is the goal, then this will mean a fair amount of weeding to control invading plants. This may have to be done two or three times a year. However, a less intensive regime will result in the



Scarlet pimpernel *Anagallis arvensis*.
Paul Glendell/Natural England



This living roof has been designed to incorporate many different habitats. ZinCo GmbH

development of a more mixed vegetation, as grasses and other plants invade. If a sedum living roof is left largely unmanaged it is likely to gradually develop into a more mixed community, with a greater proportion of grasses in the vegetation. However, some maintenance – even if you only intervene once a year – should be done to remove invading woody plants (such as birch tree seedlings) that have the potential to disrupt, or even puncture, the waterproof lining of the roof.

Wildflower roofs

For extensive living roof types it should be possible to develop a wildflower meadow with little or no intervention. Low fertility substrates will give rise to

short vegetation that will not need cutting back each year. Where growth is more productive or tall – as on a semi-extensive living roof – it will be necessary to cut back and remove growth every year. This will prevent the died-back remains of the previous season's growth, accumulating on the surface of the roof. Unlike conventional meadows, which are normally cut in summer, it's recommended that roof meadows are cut back in late winter. Leaving the dried and dead vegetation in place not only provides over-winter shelter for invertebrates and food for seed-eating birds, but also a degree of protection to the plants beneath it during severe weather. It can also look attractive.



Field scabious *Knautia arvensis*, although in this case the field is on the top of a building!
Mathew Frith

Bugs and living roofs

Common, widespread and highly mobile invertebrates will easily colonise living roofs. Examples found so far include many ladybird species as well as various shieldbugs, hoverflies, bees and grasshoppers. But since these species occur anyway in our well-tended and nutrient-rich gardens, living roofs offer them little extra. However, the owner of a good, dry grassland roof can hope to attract some of the more unusual and scarce insects that are linked with similar habitats in the wild.

A key feature of living roofs is that the growing medium is made up of substrates such as crushed brick with only a little soil mixed in. This means that they are nutrient-poor, sparsely vegetated, well-drained and both dry and warm, with areas of bare ground. In turn, the invertebrates they support are those that are warmth-loving (or heat tolerating) species. These tend to be those with a rather Mediterranean distribution in Europe, and which in Britain are therefore right at the very northern and western edge of their range.

Such species are normally associated with habitats such as sandy heaths, chalk downs, coastal cliffs, dunes and brownfield sites (land that was previously developed, then left to run wild). As a result of changing land use, many of these formerly open habitats are now in danger of becoming smothered by scrub and so losing their important floras and faunas. Many nationally scarce insect species occur on brownfield sites and some of these are now turning up on living roofs in England.

Try to imagine a living roof as a rockery, with boulders, gravel and other rough, dry substrates decoratively arranged with only a little soil. Instead of the traditional alpine and succulent garden plants, populate it with native species. Plants like kidney vetch *Anthyllis vulneraria*, horseshoe vetch *Hippocrepis comosa*, bird's-foot-trefoils *Lotus* species, salad



The insects found in dry, warm habitats often include the rare and the unusual, for example (from top) a squashbug *Syromastus rhombeus*, a weevil *Ceutorhynchus geographicus* and the leafhopper *Aphrodes bifasciatus*.
Roger Key/Natural England

burnet *Sanguisorba minor*, toadflax *Linaria vulgaris* and native grasses are all associated with unusual insects which feed on them. Clovers – *Trifolium* species – are valuable forage plants for bumblebees, including the declining *Bombus sylvarum* and *B.*

humilis. Wild mignonette *Reseda lutea* and weld *R. luteola* are visited by tiny white-faced bees (*Hylaeus* species), many of which are very rare. Other important nectar and pollen sources for bees, wasps, hoverflies and butterflies are ox-eye daisy *Leucanthemum vulgare*, various hawkbits (*Leontodon* species), and common cat's-ear *Hypochaeris radicata*.



Wild mignonette *Reseda lutea*.
Roger Key/Natural England

A good living roof will also attract ground-dwelling insects such as predatory ground beetles and root- or seed-eating invertebrates. These particularly favour loose, dry soil into which they can burrow among the plant roots, or areas under larger rocks and stones. Such soil also suits a wide range of soil-nesting solitary bees and wasps. Unusual visitors you might see include the bombardier beetle *Brachinus crepitans*, the Adonis ladybird *Hippodamia variegata*, mining bees and sand wasps, such as the sand-tailed

digger wasp *Cerceris arenaria* and the ornate-tailed digger wasp *C. rybyensis*.

Small logs laid across the substrate will not only provide shelter for insects but also make nesting sites for the many small bees and wasps that burrow into dead timber. Unlike logs resting in the moist humus of garden topsoil – which rot down through the actions of beetle larvae and worms – these roof logs become sun-baked and hard, providing a different but nevertheless important habitat for insects.



A mining bee *Andrena clerkella* laden with pollen. Roger Key/Natural England



The sand-tailed digger wasp *Cerceris arenaria*. Roger Key/Natural England



Sun-baked logs make a valuable habitat for many species. Dusty Gedge/Livingroofs.org

Butterflies

A living roof is a great place to encourage those butterfly and moth species not normally found in rich, lush gardens. Being both low in nutrients and well-drained, such roofs allow food plants for a number of important butterfly and moth species to flourish. Horseshoe vetch, kidney vetch and bird's-foot-trefoil, for example – all with beautiful yellow flowers – are important food plants for butterflies such as the dingy skipper and the common blue. As with other invertebrates, some of the species in the list on page 22 like bare areas of brick, shingle or gravel on which to sun themselves.

Butterflies associated with dry habitats that may use living roofs

Species	Substrates	Foodplants
Brown argus	Chalk to acid	Rock-rose, dove's-foot crane's-bill, stork's-bill species
Common blue	Chalk to acid	Mainly bird's-foot-trefoil species and black medick
Dingy skipper	Chalk, neutral	Horseshoe vetch and bird's-foot-trefoil species
Grayling	Heath, sand, chalk	Grasses
Small copper	Chalk to acid	Common and sheep's sorrel
Small heath	Chalk to acid	Fine grasses
Wall	Chalk to acid	Grasses



The grayling butterfly *Hipparchia semele* prefers grasses. Roger Key/Natural England

Birds

Even a small living roof can provide a good feeding area for common bird species such as blackbird, song thrush, robin and wren. Dry grassland roofs, with plenty of good seed plants will attract seed-eating birds such as goldfinch, linnet, greenfinch and chaffinch. If the roof is in Birmingham or London it may even attract a black redstart, a bird rare in Britain but one well known for using living roofs on the Continent.

Designing living roofs for wildlife

The best design is one that provides a range of microhabitats for wildlife. Even a small roof may provide a number of miniature habitats, ranging from the bare and dry to the tall and verdant, benefiting many plants and bugs. Do, therefore, think about the following, if the structure allows:

- Try to ensure that your roof has areas of shingle, gravel and stones that will remain relatively bare. Such areas will provide a sanctuary for species that like bare, dry ground. Small



A Black redstart. Rare in Britain, these birds often use living roofs on the Continent. B. Borrell Casals/FLPA.



Robins will be attracted by the invertebrate food to be found on living roofs. Chris Gibson/Natural England



A green oasis. Dusty Gedge/Livingroofs.org

geometric areas covered in gravel, or the addition of rock cairns, can also give a 'landscape' feel to a living roof. On a deeper semi-extensive roof, consider having some shallow, bare areas to increase the range of habitats.

- Even on shallow extensive living roofs there may be areas that can hold deeper substrates. If there is a supporting structure such as a wall

or a pillar below, a mound or a ridge of deeper substrate could be applied above. This will allow taller vegetation to grow.

- Placing small boulders and dry rotting logs on the roof can provide important microhabitats for bugs, fungi and other species.
- Use a native seed mix or plug plants, preferably from a recognised

supplier. A cheaper alternative is to collect your own seeds from a local meadow, wasteland or dry grassland site (assuming you have permission from the owner!)

Enjoy it!

Designing and tending a living roof in the garden should be fun. If, over time, things do not develop quite as expected then add a little more substrate where possible or sow a few more seeds, or both. Get up on to the roof and have a look at the bugs and beasts that you have attracted. Above all, let other people know and help spread the word!

Please remember to seek out and follow all relevant safety advice when accessing roofs and high places.

In the construction industry around one-quarter of all deaths and serious injuries are due to falls from ladders. If using a ladder or other equipment, please refer to and follow the manufacturer's safety instructions.

Both Natural England and Livingroofs.org are keen to hear from people who have made a living roof in or around their garden. Please contact: gardenroofs@livingroofs.org.uk or steve.berry@naturalengland.org.uk

Contacts

For further information on living roofs and biodiversity go to www.livingroofs.org or www.greenroofs.com. There is a forum at www.livingroofs.org where you can ask for advice on domestic living roofs and exchange experiences.

Natural England

1 East Parade
Sheffield, S1 2ET
Enquiry Service: 0845 600 3078
enquiries@naturalengland.org.uk
www.naturalengland.org.uk

Buglife

170A Park Road
Peterborough, PE1 2UF
Tel: 01733 201 210
www.buglife.org.uk

Royal Horticultural Society

80 Vincent Square
London, SW1 P 2PE
Tel: 020 7834 4333
info@rhs.org.uk

The Wildlife Trusts

The Kiln
Waterside
Mather Road
Newark, NG24 1WT
Tel: 01636 677711
www.wildlifetrusts.org

Plantlife

14 Rolleston Street
Salisbury
Wiltshire, SP1 1DX
Tel: 01722 342 730
www.plantlife.org.uk

Further information

This is one of a range of wildlife gardening booklets published by Natural England. For more details, contact the Natural England Enquiry Service on 0845 600 3078 or e-mail enquiries@naturalengland.org.uk.

Natural England also produces *Gardening with wildlife in mind* an illustrated wildlife reference. Originally on CD but now also available on-line, *Gardening with wildlife in mind* has detailed information on 800 plants and animal species often found in our gardens, and shows how they are ecologically linked. See www.plantpress.com

Other titles

Nigel Dunnet & Noel Kingsbury
Planting Green roofs and living walls.
Timber Press 2004

Green roofs: their existing status and potential for conserving biodiversity in urban areas. Natural England Research Report No. 498. 2003

Jacklyn Johnson & John Newton.
Building green: a guide to using plants on roofs, walls and pavements. 2004
Available from www.london.gov.uk