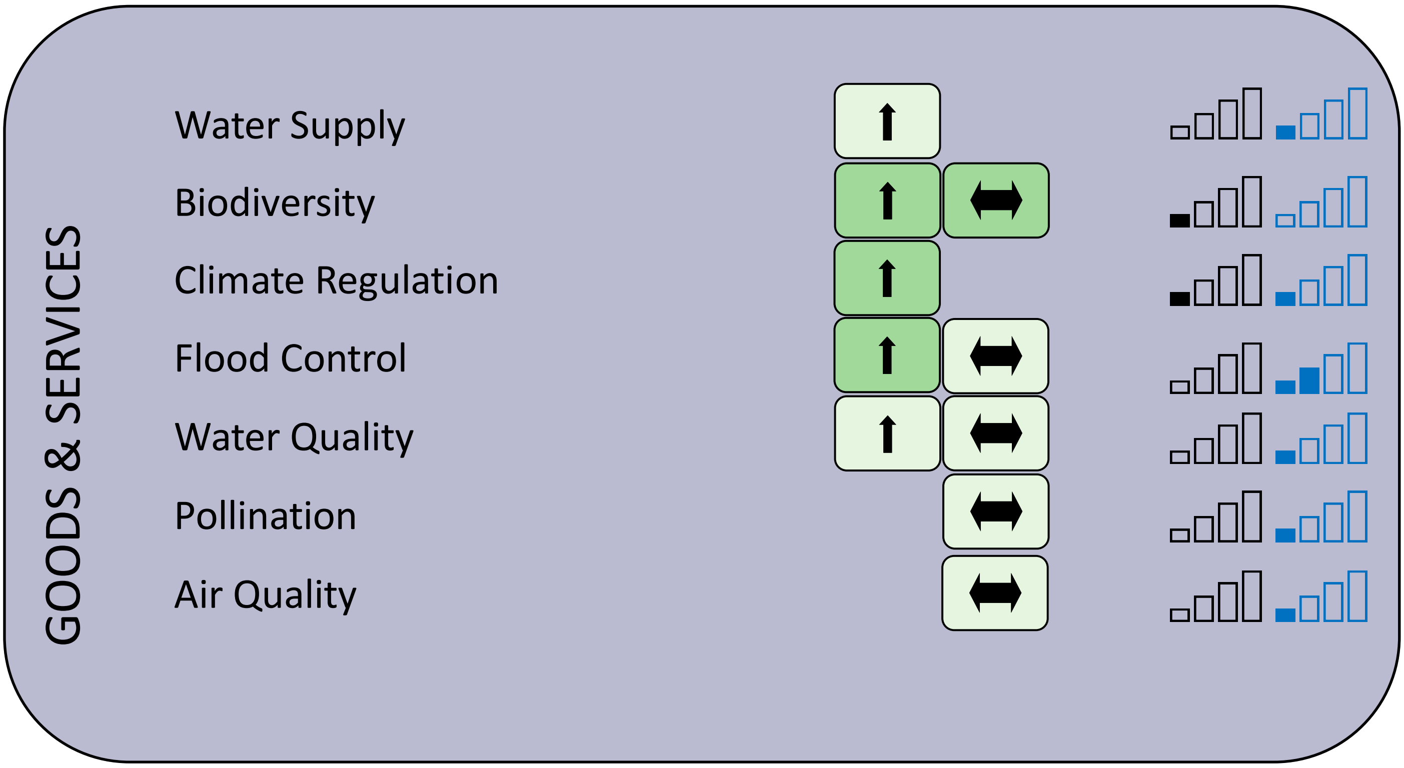
Encourage the planting of green roofs.

MANAGING ECOSYSTEM SERVICES

URBAN

PLANT GREEN ROOFS



These pages represent a review of the available evidence linking management of habitats with the ecosystem services they provide. It is a review of the published peer-reviewed literature and does not include grey literature or expert opinion. There may be significant gaps in the data if no published work within the selection criteria or geographical range exists. These pages do not provide advice, only review the outcome of what has been studied.

Full data are available in electronic form from the Evidence Spreadsheet.

Data are correct to March 2015.

KEY

Quality of Evidence

Good

Medium

Poor

Quantity of Evidence

Number of sources showing direct evi-

Number of sources showing indirect evidence

Magnitude and Direction of Effect

Direction

Magnitude

Strong

Medium

Low

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Provisioning Services—providing goods that people can use.

Cultural Services—contributing to health, wellbeing and happiness.

Regulating Services—maintaining a healthy, diverse and functioning environment.

PROVISIONING

Water Supply: ***Moderate Evidence***:- A study from Germany, largely based on simulations, suggests that a combination of green roofs and rainwater management systems, such as swales, can restore the groundwater to pre-development levels[1]. The study suggests that for one urban housing development, 30% of houses would need green roofs to return groundwater levels to the natural state. ***Weak Evidence:-*** An experimental study in the USA suggested that soil depth on green roofs was a key parameter in improving water retention and run-off lag-time[2].

CULTURAL

Biodiversity: *Strong Evidence:-* A study from Nova Scotia, Canada, compared insect diversity on green roofs with that on adjacent ground-level habitat patches[3]. It found that there were no differences in species richness or abundance between green roofs and adjacent patches, although there were slight differences in species composition. This supports the idea that green roofs can contribute to urban biodiversity. In the UK, bat activity was monitored in relation to green roofs and types of green roofs (*Sedum* or 'biodiverse')[4]. Bat activity was significantly higher over biodiverse roofs compared with conventional roofs, suggesting that green roofs may provide good bat foraging habitat in urban environments. A review of the benefits to urban biodiversity of green roofs suggests that while green roofs support generalist invertebrate species, their role in encouraging rarer taxa has not been demonstrated[5]. There is also a lack of data for other taxa, especially vertebrates.

REGULATING

Climate Regulation: *Moderate Evidence:-* A modelled approach to the adoption of green roofs in Chicago USA suggests that they could potentially reduce the temperature in the urban environment by as much as 3°C, the same as using white or reflective rooftops[6]. The study does suggest however that increased humidity associated with the water-retention and transpiration capacity of green roofs would not bring any cooling benefit. A study from Nova Scotia (USA) found that the species composition of green roofs is important, with dryland species appearing to function better at reducing roof temperatures and intercepting storm water[7]. Planting both dry and wetland plants did not reduce performance greatly and boosted diversity, though monocultures of *Sibbaldiopsis tridentata* (three toothed cinquefoil) were found to be the best performing overall. Conversely, a different study from Nova Scotia found that planting mixtures provided most benefits to both summer cooling and water-retention, particularly combinations of tall forbs, grasses and succulents[8].

Flood Control: Strong Evidence:- A laboratory study from the UK into the species composition of dry roofs and their ability to retain water and delay or reduce run-off found that grasses were most effective, followed by forbs and sedums[9]. Plant species with taller height, larger diameter and larger shoot and root biomass were found to be better, with sedum roofs having higher run-off than bare soil. In contrast, a different study from the USA found that run-off was largely independent of plant type, but that soil depth improved water retention and runoff lag-time[10]. ***Moderate Evidence:-*** The main role of green roofs in flood control is in reducing and delaying storm water run-off. Dryland species were found to be the best performing in a USA study but this may have been because they tended to have greater cover[7]. Conversely, a different USA study found that mixtures of tall forbs, grasses and succulents performed best overall[8].

Water Quality: *Moderate Evidence:-* Green roofs provide some degree of pH normalization of rainwater, as found in a study from the USA, but this does not appear to be a function of substrate depth, while conductivity increased with increased substrate depth but decreased with the presence of vegetation[10]. A study from the USA found that green roofs do not appear to act as significant sinks for heavy metals, suggesting that widespread use in urban systems would not reduce heavy metal input into the storm-water system[11].

Pollination: *Weak Evidence:-* A study from the USA found that greens roofs with prairie type planting had fewer pollinating bees than equivalent vegetation at ground level[12]. Green roofs may therefore not contribute much to pollination services.

Air Quality: *Strong Evidence:-* The ability of green roofs to capture 10µm particulate matter (PM10) pollutants in Manchester was examined with regard to different vegetation types[13]. The most effective species were the grasses *Agrostis stolonifera* and *Festuca rubra*. However, a maximum green roof installation in the city centre of 325 ha would only achieve a 2.3% reduction in PM10 annually.

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