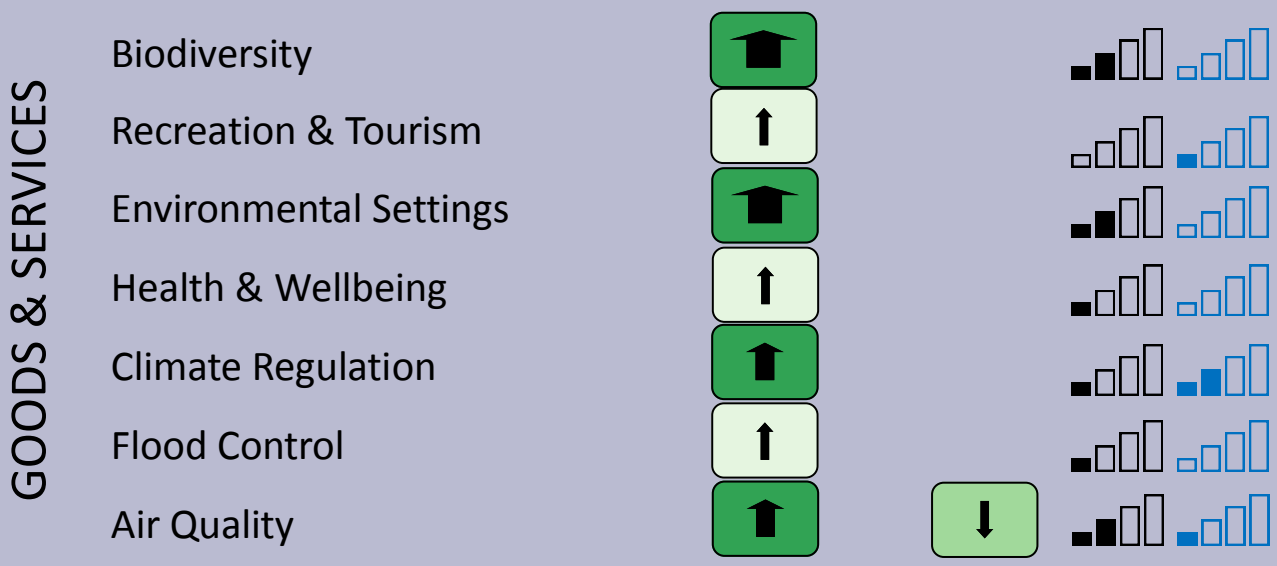
Increase the area of urban woodland and the planting of trees.

MANAGING ECOSYSTEM SERVICES

URBAN

INCREASE URBAN TREES AND WOODLANDS

GOODS & SERVICES

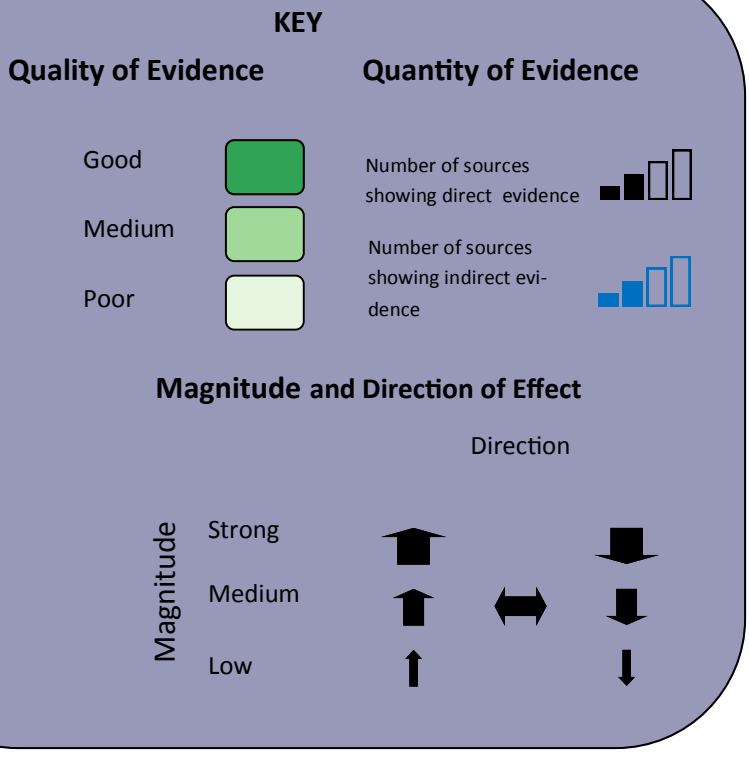


These pages represent a review of the available evidence linking management of habitats with the ecosystem services they provide. It is a review of the published peer-reviewed literature and does not include grey literature or expert opinion. There may be significant gaps in the data if no published 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



MANAGING ECOSYSTEM SERVICES

URBAN

INCREASE URBAN TREES AND WOODLANDS

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.

CULTURAL

Biodiversity: ***Strong Evidence:-*** Data from urban woodlands in France has shown that small woodlands in urban areas can maintain significant bird diversity, with some 50% of the species found in peri-urban environments occurring in urban woodlands[1]. This finding is supported by data from Finland that found 22 species in the countryside, 12 species in urban parks and 7.4 species in the city centre[2]. Park size is an important consideration, studies from Spain and Finland found that parks of 10-35 ha would contain most of the cities species[3], and that size was the most important factor in determining species richness[4]. Structural diversity is important in wooded green space, with bird species richness in the Czech republic peaking in urban green space that was half-forested[5]. In Sweden, the understory was found to be an important predictor of bird diversity, with clearing of the understory for management reasons having a negative impact on bird diversity[6]. The presence of trees in a Swiss study suggests that bird numbers would increase from 13 with no trees to 20 species with 46% tree cover[7]. Connectivity between tree patches using lines of woodland or trees is important for birds in Spain[8], and Pipistrelle bats in Birmingham[9].

Recreation and Tourism: ***Weak Evidence:-*** Urban remnant woodlands of high ecological value are also often used for informal outdoor recreation. However, they often attract property developers and so are under threat of development[10].

Environmental Settings: ***Strong Evidence:-*** Trees can encourage the use of outdoor spaces and the exchange of information as shown by a study in Chicago USA which demonstrated that green spaces, especially those with trees, attracted more people from a wider demographic range than spaces devoid of nature[11]. Neighbourhood satisfaction in Texas was positively correlated with trees, and negatively with commercial land use[12], while neighbourhood social ties depend on the extent to which the area has trees and grass[13]. More connected, less isolated and less fragmented areas of trees generated higher feelings of neighbourhood satisfaction in Texas, USA[14].

CULTURAL

Environmental Settings: ***Moderate Evidence:-*** Retail land use in the USA was found to be more acceptable if there were trees associated with it[15]. The amount of social activity within a green space appears to depend on the amount of trees and grass, with more barren spaces having less social activity[16]. Green spaces also affect house prices, with a study from Finland showing that proximity to green space positively influences house prices[17], and a single tree can increase the rental value of a house in Oregon, USA, indicating the cultural and social value placed on trees[18].

Health & Wellbeing: ***Strong Evidence:-*** Children who lived on streets in New York, USA with more trees were more physically active and had smaller skin-folds, a measure of obesity[19].

REGULATING

Climate Regulation: ***Strong Evidence:-*** An estimated 231,521 tonnes of carbon is stored above ground in the vegetation of Leicester, with 97.3% being associated with trees, the majority of which are on publically owned or managed sites[20]. On golf courses, trees are a net sink of CO_2 so that even intensively managed areas could provide some carbon offset[21]. A model of this applied to Leipzig, Germany, suggests that parks with trees could absorb significant amounts of Carbon[22]. For smaller scale climate regulation and heat island effects, small urban green spaces with trees have been shown to reduce temperatures in Lisbon, Portugal[23], and also in Phoenix Arizona, but at the cost of loss of soil water[24]. While local cooling can occur, the effects of cooling on the city-wide scale are less clear[25], and one study from the USA suggests that reflective buildings have a higher benefit than green spaces and trees[26]. In Los Angeles, shade trees reduce power consumption for cooling, saving an estimated 10-11 kg of carbon emissions per tree per year[27]. This effect could amount to a saving of 20% in energy use from air conditioning[28]. ***Moderate Evidence:-*** A study from two houses in California found that energy savings from shade trees could be as much as 30% of the domestic energy use[29]. As well as shading, trees can also potentially save heat through wind reduction as shown in a model based around Toronto, Canada[30]. Shading by trees in summer can potentially save 30-40% of the energy used for cooling, and 10-20% of the energy used for heating[31].

REGULATING

Flood Control: ***Moderate Evidence:-*** Soils in UK city green spaces are less compacted than those on agricultural land, especially under trees and shrubs[32]. This should mean that water is less likely to run off but soak into soils reducing the flood risk. A study from Portugal estimates the value of trees for storm-water runoff reduction as $47.80 per tree annually[33]. **Weak Evidence:-** Urban trees and grasslands are suggested to aid water infiltration and reduce surface run-off and hence reduce flood risk[34].

Air Quality: ***Strong Evidence:-*** In Chile, urban forests were found to be an effective way of removing 10µm particulate matter (PM10) from the air[35]. This concept has been incorporated into a planning model for UK cities to assess the level of PM10 reduction that can be achieved by tree planting[36]. In these situations, increasing total cover of trees in the West Midlands from 3.7% to 16.5% would reduce PM10 concentrations by 10%, and in Glasgow, increasing tree cover from 3.6% to 8% would reduce PM10 concentrations by 7%[37]. Conifers, such as *Pinus nigra* and *Cupressus leylandii* were more effective at removing PM10 by virtue of their finer divided leaves[38,39]. The benefits of trees at removing pollution is especially marked in 'street canyons' where 40% of nitrogen dioxide (NO_2) and 60% of particulate matter can be removed[40]. In London, it is estimated that 0.7-1.4% of PM10 is removed by urban trees currently, and that to maximise benefit, trees should be targeted at the most polluted areas using conifers[41]. Ozone is also removed by trees, and a study from Rome, Italy, suggests that trees contribute an estimated $2-3 million to health care reduction through removal of ozone[42]. A beneficial effect was also shown in peri-urban forests around Madrid, Spain, with forests removing ozone with a suggested knock-on effect on health[43]. Some tree species can worsen ozone problems by producing ozone from reactions on the leaf surface between nitrogen oxides (NOx) and biogenic volatile organic compounds (BVOC)[44], the oaks, willows and poplars can produce the most ozone, while pine, larch and silver birches generally reduce it. The emission of BVOC can complicate the cost-benefit analysis of air quality regulation by urban trees[45].

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