4 Services provided by nature

4.1 This section provides evidence about the different services provided by nature. Specific services may be of interest to different policy makers and practitioners, so you may choose to focus just on those. Alternatively, you may be interested in overarching themes such as economic competitiveness, so **Chapter 2** and **Chapter 3** may be useful in identifying how the environment contributes to those themes.

4.2 It is important to note that not all services provided by nature are included here. The ones chosen are the ones which on the basis of current evidence are most important in the context of environmental projects. The ones selected are also those for which we have available scientific and economic evidence.

4l Temperature regulation

Evidence suggests that the natural environment makes a contribution to regulating the local climate and reducing temperature-related health and environmental impacts. Future climate change may make this benefit particularly significant.

Introduction

4.69 Temperature regulation of indoor and outdoor spaces is essential for human health and wellbeing. In the UK, an estimated 25,598 to 57,355 people die each year due to the cold, with disadvantaged groups in society being disproportionately affected. An estimated 1,142 people die each year due to heat-related illnesses (Hames and Vardoulakis 2012).

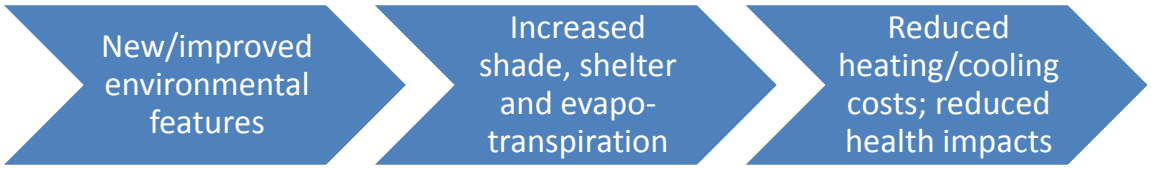
4.70 In the context of climate change, managing high temperatures is recognized as being a key concern, particularly for the elderly and other at-risk groups. Respiratory and cardiovascular diseases are made worse at higher temperatures, and this is partly due to interactions with air pollution, which also becomes worse at high temperatures. In England in summer 2006, there were an estimated 75 additional deaths per week for each degree of increased temperature (Armstrong et al. 2010, cited in Public Health England 2013).

4.71 The Urban Heat Island effect is the term used to describe the situation where urban centres become significantly warmer than the surrounding countryside, particularly at night. During heat waves in August 2003 and July 2006, night time temperatures in London were 6-9 degrees Celsius higher than those in rural locations south of London (Greater London Authority 2006). The Urban Heat Island effect is caused by the large area of heat absorbing surfaces, high energy use and reduced wind speed (Bolund and Hunhammar 1999) and leads to night-time temperature remaining high, increasing human health risk (Kovats 2008).

4.72 Higher temperatures affect not only human health, but plant and animal health as well. River water temperatures, for instance, are expected to rise by 2 to 4°C by 2050, and this can impact on the health of freshwater wildlife such as trout and salmon (Environment Agency 2011).

4.73 This section reviews the evidence that the natural environment can make an important contribution to regulating local temperatures, reducing the heating and cooling costs of indoor spaces, and reducing health impacts.

Theory of change



How strong is the evidence?

4.74 The evidence that the natural environment can positively impact on local climate is strong. As with all other benefits, context is important.

Evidence

- Green infrastructure makes a number of important contributions to local climate regulation. Watery areas can help to stabilise temperatures. A single large tree can transpire 450 litres of

water in a day which uses 1000 mega joules of heat energy, making urban trees an effective way to reduce urban temperature (Bolund and Hunhammar 1999).

- Urban parks are on average 1 degree cooler than built up areas during the day (Bowler, Buyung-Ali et al. 2010), but the type of park does matter – parks with hard paved surfaces and few trees or shrubs can be hotter (Chang, Li et al. 2007).
- Rising temperature in rural areas may threaten valuable biodiversity, such as salmon and trout. An experiment in the New Forest found that river shading from trees prevented water temperature from reaching the lethal limit for brown trout, and maintained water temperatures at around 5 degrees Celcius below those in rivers surrounded by open grassland (Broadmeadow, Jones et al. 2010).
- Modelling of the impact of trees on a two-storey office building in Scotland found that using trees as a shelterbelt could potentially reduce office heating energy use by 3.64 kilowatts per square metre of floor area (18.1 percent of total heating energy use) over the heating season from October to April (Liu and Harris 2008)[122].
- Green roofs have been found to significantly reduce energy use in poorly insulated buildings, however offer little advantage in modern buildings designed to 2006 UK building regulations. Retrofitting is a realistic option for many older buildings, especially the 50 percent of total UK building stock constructed prior to 1965 (Castleton, Stovin et al. 2010).

Link with climate change

- The central estimate of average summer temperature increase in the South East of England is 1.6 degrees during the 2020s, 2.3 degrees in the 2040s, and 3.9 degrees in the 2080s (Department for Environment Food and Rural Affairs 2009)[123].
- Gill, Handley et al. (2007) found that a 10 percent increase in the amount of green cover in high-density residential areas in Manchester could prevent climate change induced temperature increases of up to 3.7 degrees Celsius by 2080. By contrast, a loss of 10 percent of green cover could result in surface temperature increases of up to 7 degrees Celsius by 2080. However the authors note that climate change-induced drought may reduce the effectiveness of vegetation in regulating temperature (Gill, Handley et al. 2007).
- A later study, also in Manchester, found that only a 3.7 percent increase in tree cover was realistically possible due to existing buildings, roads and other structures. However this could prevent increases in local temperatures of between 0.5 to 2.3 degrees Celcius by 2080, depending on the housing density (Hall, Handley et al. 2012)[124].
- The Climate Change Risk Assessment suggests that there could be between 580 to 5,900 additional heat-related deaths per year by 2050 in the UK. However, it is also expected that there could be a decline in the number of cold-related deaths, in the order of 3,850 to 23,900 per year (Hames and Vardoulakis 2012)[125].

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[122] The strength of this effect will be heavily influenced by the local temperature, wind speed and design of the shelterbelt, so is not directly transferable to other locations.

[123] This has been estimated by the Department for Environment, Food and Rural Affairs, based on comparison of world leading climate projection models. The figures presented are for the 'medium emissions' pathway. The warming is projected against a 1961-1990 baseline which means that some of it has already happened. These results are based on the central estimate which effectively assumes business as usual with regard to carbon emissions globally.

[124] As with Gill, Handley et al. (2007), climate change may reduce the effectiveness of vegetation in regulating temperature.

[125] The wide range of the estimates presented in this report is a reflection of the high level of uncertainty associated with the likely impacts of climate change on heat and cold-related deaths, and the extent to which people are able to adapt to the change in temperatures. As such it should be taken as indicative only.

References

Bolund, P. and S. Hunhammar. 1999. "Ecosystem services in urban areas." Ecological Economics **29**(2): 293-301.

Bowler, D., L. Buyung-Ali, et al. 2010. How effective is 'greening' of urban areas in reducing human exposure to ground level ozone concentrations, UV exposure and the 'urban heat island effect'? Collaboration for Environmental Evidence. Bangor, Bangor University.

Broadmeadow, S., J. Jones, et al. 2010. "The influence of riparian shade on lowland stream water temperatures in southern England and their viability for brown trout." River Research and Applications **27**(2): 226-237.

Castleton, H., V. Stovin, et al. 2010. "Green roofs; building energy savings and the potential for retrofit." Energy and Buildings **42**: 1582-1591.

Chang, C., M. Li, et al. 2007. "A preliminary study on the local cool-island intensity of Taipei city parks." Landscape and Urban Planning **80**(4): 386-395.

Department for Environment Food and Rural Affairs. 2009. Adapting to climate change: UK climate projections. Department for Environment Food and Rural Affairs. London.

Environment Agency. 2011. Keeping Rivers Cool: Getting ready for climate change by creating riparian shade. Bristol, Environment Agency.

Gill, S., J. Handley, et al. 2007. "Adapting Cities for Climate Change: The Role of the Green Infrastructure." Built Environment **33**(1): 115-133.

Greater London Authority. 2006. London's Urban Heat Island: A Summary for Decision Makers. London, Greater London Authority. **October 2006**.

Hall, J., J. Handley, et al. 2012. "The potential of tree planting to climate-proof high density residential areas in Manchester, UK." Landscape and Urban Planning **104**: 410-417.

Hames, D. and S. Vardoulakis. 2012. Climate Change Risk Assessment for the Health Sector. UK 2012 Climate Change Risk Assessment. H. Wallingford. London, Department for Environment, Food and Rural Affairs. **January 2012**.

Kovats, S. E. 2008. Health effects of climate change in the UK 2008: : An update of the Department of Health report 2001/2002. Health Protection Agency.

Liu, Y. and D. Harris. 2008. "Effects of shelterbelt trees on reducing heating-energy consumption of office buildings in Scotland." Applied Energy **85**: 115-127.

Public Health England. 2013. "Heatwave Plan for England 2013." Retrieved November 18th, 2013, from **https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/201150/Heatwave_plan_2013_-_Making_the_case_Accessible_updated.pdf**.