# 1. Natural environments & human health: an overview

This is the first in a series of four evidence report cards summarising what we know about: (a) natural environments and human health; and (b) opportunities for promoting human health and wellbeing through sensitive public open space management.

Each card focuses on 'green' and 'blue' public open spaces characterised by the presence of diverse natural features. These include, for example, parks, woodlands, trails, community gardens, beaches, coastal paths, and incidental 'informal' green spaces (e.g. street or railway verges, riverbanks, abandoned vegetated brownfield land and so forth). The cards are intended to inform policy and practice decisions, focussing on investment in, and management of, Cornwall's public open spaces, for example through Cornwall Council's Public Open Space Standards.

## Green space[1] and human health: top-level findings

A growing body of evidence has accumulated over the last 40 years identifying positive associations between the presence of green space in the living environment and a range of human health outcomes. Although complicated by the use of varied indicators of green space exposure and cross-sectional study designs (which *can only show 'association' not 'causation'*), population-level studies tend to link greener living environments with:

- **Lower all-cause mortality** and **reduced cardiovascular disease mortality** (Gascon et al., 2016);
- **Positive pregnancy and birth outcomes**, including healthier birth weight and lower infant mortality risk (James et al., 2015);
- **Better perceived mental health** (van den Berg et al., 2015).

Although less consistent, studies have also examined associations between residential greenness and reduced rates of obesity, type 2 diabetes, and respiratory disease (Lovell, 2016a,c). Associations with cancer, musculoskeletal health and allergies are less clear (as outlined in a recently published series of Natural England evidence briefings).

## What are the pathways to health and wellbeing?

Identifying the specific pathways by which natural environments may influence health and wellbeing is challenging (Lachowycz and Jones, 2013) due to the complex and varied ways in which different people encounter and experience diverse nature-based settings over time (Bell et al., 2014). Pathways examined to date suggest these settings may contribute to:

- Improved **environmental quality**, such as reduced air pollution/urban heat (Kuo, 2015).
- Enhanced **immuno-regulation** through exposure to microbial biodiversity (Sandifer et al., 2015).
- Opportunities to engage in pleasurable forms of **physical activity** (Bowler et al., 2010; Thompson Coon et al., 2011).
- Feelings of **relaxation and restoration**, acting as less imposing and more relaxing sensory environments during times of stress or cognitive fatigue (Hartig et al., 2014).

[1] Note: As is common in much of the evidence, **green space** is largely used throughout the evidence cards as a short-hand for all types of natural environment, from urban parks to forests to beaches.

- Valued forms of **social interaction**, nurturing a sense of belonging, community cohesion and reduced social isolation (Völker and Kistemann, 2011; Husk et al., 2016).
- Enhanced **emotional wellbeing,** engendering feelings of inspiration and connectedness to a broader reality beyond the worries of day-to-day life (Keniger et al., 2013).

## Who is using green spaces?

Associations between human health and presence of greener living environments tend to vary with **socio-economic status, age, gender and ethnicity**. This may be indicative of those who feel able to access, use and feel comfortable within their local green and blue spaces. Natural England's Monitor of Engagement with the Natural Environment (MENE) survey notes that natural environment visits are highest amongst people aged 25-64, in employment, and in higher socio-economic groups. Conversely, visits are lowest amongst those aged 65 and over, and members of Black and Minority Ethnic (BAME) and/or lower socio-economic groups (Natural England, 2013).

Differences in use may relate to variations in **physical and perceived access** to **good quality** green spaces (Mitchell and Popham, 2007). For example, adults with limited mobility often struggle to negotiate the terrain of their local public open spaces (Sugiyama et al., 2009), whilst low socio-economic and ethnic minority groups typically have access to fewer parks and/or to parks of lower quality than more privileged groups (Roe et al., 2016). This renders certain individuals vulnerable to **green space exclusion**, thereby undermining the potential for residential greenness to reduce population-level health inequalities (Mitchell and Popham, 2008; O'Brien et al., 2010).

## Which green spaces?

Studies are increasingly comparing people's use and enjoyment of **different green space types**. For example, White et al. (2013a) used data from Natural England's MENE survey (2009-2011) to examine feelings of restoration (calmness, relaxation and revitalisation) after visiting varied natural environments. All visits were associated with feelings of restoration, but based on a fine-grained analysis of 16 environment types, the highest levels of restoration were associated with visits to **coastal environments**, **woodlands/forests,** and **hills/uplands/mountains**. Whilst some urban green spaces (e.g. playing fields) were associated with lower restoration than open countryside and country parks, **other urban green spaces (e.g. town parks) were on average just as restorative as these countryside settings**, perhaps valued for fulfilling more practical aspects of everyday green space interaction (Research Box et al., 2009). Building on this, Wheeler et al. (2015) investigated the links between different land-cover types and population health outcomes measured in the 2011 Census; populations in areas with more grassland, broadleaf woodland and coastal zones were more likely to report better general health.

Research has also indicated potential health and wellbeing values of urban street trees (Taylor et al., 2015; Salmond et al., 2016). A large body of research examining the **social value of woodlands and forests** in the UK has been published by Forest Research (Forestry Commission) and is available to download online. This complements a larger international body of work highlighting the benefits of forests for providing recreational opportunities, as well as affording physiological and emotional wellbeing benefits amongst regular users (Williams and Harvey, 2001; Skår, 2010; Tsunetsugu et al., 2010).

Of particular relevance to Cornwall, the **specific benefits of blue space** for health and wellbeing are also gaining increasing research and policy attention (Völker and Kistemann, 2011, 2013; White et al.,

2016). At a population level, studies have identified positive associations between coastal proximity and indicators of general health, mental health and physical activity (Bauman et al., 1999; Witten et al., 2008), even after controlling for the level of green space in the living environment (Wheeler et al., 2012; White et al., 2013b, 2014). Smaller-scale studies (e.g. in Cornwall, New Zealand, Australia) highlight a **strong sense of connection to the sea** amongst coastal residents, noting its contribution to their sense of belonging; somewhere they feel rooted and 'at home' (Game and Metcalfe, 2011; Kearns and Collins, 2013; Bell et al., 2015).

## The importance of biodiversity

The **specific role of biodiversity** in promoting human health and wellbeing is gaining increasing research and policy attention. Although recognised as integral to the provision of ecosystem goods and services at national and international scales (e.g. carbon dioxide reduction, pollination, water quality and storage etc.), limited consideration has been given to its potential to promote psychological benefits or to encourage healthier behaviours such as physical activity and social interaction at more local scales (Clark et al., 2014).

As such, whilst there is increasing evidence to suggest that contact with 'nature' can benefit human health and wellbeing, an important question remains; *can a species-poor green space deliver equivalent health benefits to a highly biodiverse green space* (e.g. a semi-natural ancient woodland)? A recent population-level study in the UK found that more diverse landscapes and higher quality environments (as indicated by, for example, protected area status or bird species richness) may be more beneficial to health than other areas (Wheeler et al., 2015).

A systematic review by Lovell et al. (2014) found that relationships between biodiversity and human health were **most apparent at local scales following immediate species encounters**. However, they warned against drawing overly simplistic conceptualisations of the relationships between biodiversity and health; they note studies where perceived rather than actual species richness was significantly associated with psychological wellbeing (Fuller et al., 2007; Dallimer et al., 2012), and highlight examples of valued ecosystems with low levels of biodiversity that are not associated with adverse health outcomes.

The challenge for green space managers and decision-makers lies in identifying opportunities for maximising the sustainability and co-existence of human health, wellbeing and biodiversity benefits within a range of public green spaces (Ives and Kelly, 2016), without causing conflict and community alienation. This is a key theme informing Evidence Report Cards 2-4.

## Potential risks to health and wellbeing

Importantly, in addition to human health benefits, there may be some risks to human health to be considered when seeking to 'green' urban areas or change existing management practices, particularly with regards to altered planting regimes and pollen, ecological connectivity and pest species, and algal blooms in shallow urban ponds.

**Pollen and allergy.** One potential risk of increased/changed planting in towns and cities is the possibility of increased allergenic pollen prevalence. Although not all pollen is allergenic, the risk of adverse reactions is considered greater in urban areas due to compounding urban heat island effects and air pollution (particularly ozone, $NO_x$ and particulate matter) (Jianen et al., 2007). Suggested measures to reduce the impacts of allergenic plant pollen include:

- *Increasing urban biodiversity* to disperse large concentrated monospecific pollen sources (Cariñanos and Casares-Porcel, 2011);
- Promoting the use of *female dioecious species*; although this may increase fruit litter, it results in lower pollen production than a predominance of male dioecious species (Cariñanos and Casares-Porcel, 2011);
- Ensuring *appropriate planting distances* between trees to promote air circulation and dilute pollen 'screen effects', particularly when natural edges and hedges are dominated by a single constituent allergenic species (Cariñanos and Casares-Porcel, 2011);
- Prioritising ecologically and economically valuable *insect-pollinated plants* rather than wind-pollinated species that produce large volumes of pollen (Lõhmus and Balbus, 2015);
- Consulting with botanists/palynologists (pollen specialists) to identify and *select species with lower allergic potential* (Lõhmus and Balbus, 2015).

**Ecological connectivity and 'pest' species.** Whilst increased green space connectivity can have benefits for human wellbeing, ecological and climate resilience (see Card 3), it could also boost the number of 'pest' species, such as ticks or brown rats, in areas that would otherwise be too small to house them or their vertebrate hosts (Medlock et al., 2013; Lõhmus and Balbus, 2015). Efforts should be made to consider the *composition* of the wildlife community rather than solely focusing on the *amount* of biodiversity, and to provide guidance on avoiding tick attacks and removing ticks properly. An understanding of the complex life cycles of disease agents and vectors in urban settings, and the likely shift in such dynamics with climate change, is needed on a case-by-case basis to maximise health benefits and minimise risks (Lõhmus and Balbus, 2015).

**Urban ponds and algal blooms.** Although SuDs promote urban climate resilience, care should be taken to avoid introducing stagnant, nutrient-rich water bodies to urban areas. In shallow water where light penetrates to the bottom, harmful algal blooms can develop, killing fish and other aquatic organisms, and posing health risks to dogs or children who play in the water (Lõhmus and Balbus, 2015). This is a particular risk in urban ponds, which can be reduced by minimising nutrient run-off and enhancing the incline of pond edges (although this must be balanced against risks associated with steep-sided water bodies).

## About these cards

This series of evidence report cards has been brought together by a partnership of the University of Exeter and Cornwall Council, funded by the University of Exeter ESRC Impact Acceleration Account. The cards bring together the latest social science and related natural scientific research from the University of Exeter and the international research community. A resource listing detailed citations and web links is available as part of the series.

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