

Valuing Cardiff's Urban Forest: A Summary Report

This report summarises the first comprehensive study on Cardiff's urban trees. The study utilised i-Tree Eco, a tool that assesses and values urban forests to inform their management.

Cardiff's urban forest is shown to be a valuable and important asset providing benefits that support the sustainability of the city and the health of residents.

Vulnerabilities in Cardiff's urban forest are highlighted, including dominance by two species, which can reduce the resilience of the urban forest to pest and disease outbreaks.

The information provided in this study offers a platform for City of Cardiff Council, residents and businesses to tackle these vulnerabilities, make informed decisions and manage Cardiff's urban forest to improve its resilience and delivery of benefits.

Cardiff has an estimated canopy cover of 18.9%

Cardiff's trees annually provide benefits worth £3.3 million to those who live and work in the city

The replacement cost of Cardiff's trees is £11 billion

Background

The urban forest comprises all the trees in the urban realm – in public and private spaces, along linear routes and waterways and in amenity areas. It contributes to green infrastructure and the wider urban ecosystem. The urban forest delivers a range of benefits to those who live and work within, including climate regulation, air pollution removal, flooding protection and habitat provision. These benefits are often termed ecosystem services.

Cardiff is one of the fastest growing cities in the UK. This expansion generates pressure on the urban forest as well as a greater need for the benefits it provides. Cardiff experiences many of the detriments associated with urbanisation, including high levels of air pollution, and risk of surface water flooding. Urban residents can also become isolated from nature and experience a lack of access to greenspaces, which has been linked to poorer physical and mental health.

Urban forests are an attractive natural means to help address these issues. Urban trees help sequester carbon and mitigate climate change, intercept airborne pollutants improving its quality, and retain rainfall reducing surface runoff and flooding. Urban trees also provide habitats to wildlife, support healthier living for residents and create a sense of place to urban areas.

i-Tree Eco is a respected, peer-reviewed model developed by the Forest Service and i-Tree Cooperative in America and used around the world. It allows for the quantification and valuation of urban trees and some of the benefits they provide. In the UK, it has been used to assess urban forests in over 20 towns, cities and parks since its pilot in Torbay in 2010.

This summary outlines the main findings of the project and recommendations for supporting the ongoing sustainability of Cardiff's urban forest.

The full report is available free from: <https://www.forestresearch.gov.uk/research/i-tree-eco>



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Methods

Data on urban trees was collected across Cardiff in the summer of 2017 from 199 plots randomly allocated across the city. The study area covered 14,064 ha and included the city centre and the surrounding rural area. Data collection followed standards described within the i-Tree Eco v6 manual. Information was collected on tree characteristics and the local environment.

The data was entered into i-Tree Eco to describe the composition and structure of Cardiff's urban forest and estimate values for a set of ecosystem services. i-Tree Eco has been adapted for use in the UK through incorporation of local weather

and pollution data. The valuation used for each service was:

- Carbon: 2017 DBEIS value of £65 / tonne CO₂e.
- Avoided runoff: avoided water treatment metered charge rate of £1.34 per m³.
- Air pollution removal: avoided health & building damage using UK social damage costs.
- Replacement cost was calculated using CAVAT (Capital Assessment Value for Amenity Trees).

Further analyses were used to assess threats by pests and diseases and capacity for tree species to provide habitat for insects and pollinators.

Composition and structure of the urban forest

Canopy cover: Cardiff has an estimated canopy cover of **2,658 ha**, covering **18.9%** of the city area. This ranks Cardiff 101st out of 312 urban areas for canopy cover.

Tree population: Cardiff has an estimated **1.4 million** trees. This is approximately 3.9 trees per Cardiff resident, or 100 trees per ha.

Structure: Trunk diameter (dbh) can be related to benefits provision with larger and older trees providing more services. Guidelines recommend having 10% of trees with dbh > 60 cm to ensure a healthy stock of trees.

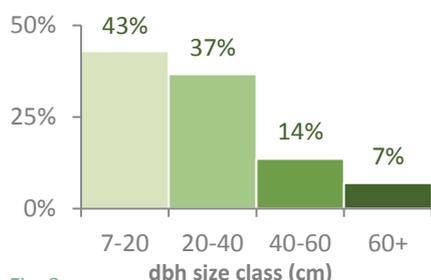


Fig. 3

Ownership: The majority of trees in Cardiff are privately owned.

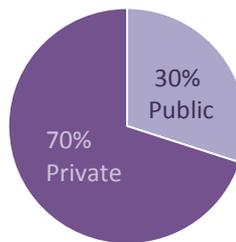


Fig. 1

Land-use: Most trees were found in agricultural land, which included trees in woodlands or forests.

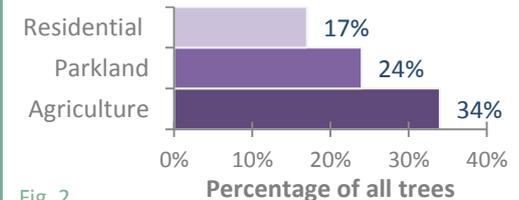


Fig. 2

Composition:

A total of **73 species** were identified in this survey. A tree population with a diverse range of tree species is more resistant to pests and diseases. Diversity of species in Cardiff is good, although ash and sycamore exceed recommendations that no species should compose more than 10% of the population.

Three of the top ten species are non-native species and **56%** of all trees were native species.

The proportion of the top ten most common species within the urban forest are displayed in Fig. 4.

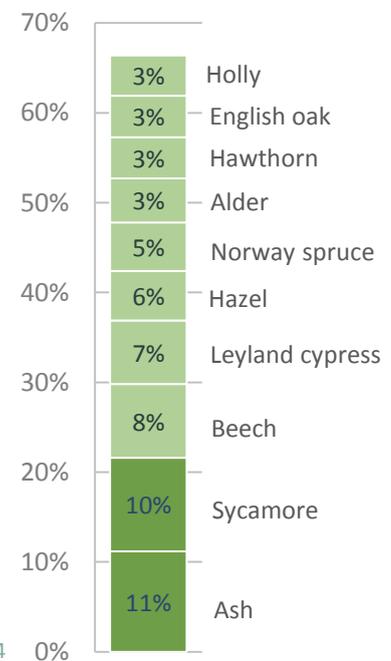


Fig. 4

Condition: 49% of Cardiff's trees were in excellent condition. The proportion in each condition category is shown in Fig. 5

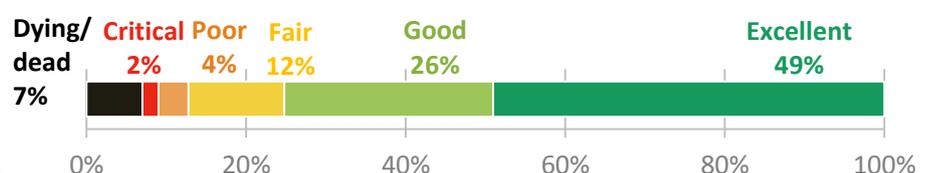


Fig. 5

Ecosystem services provided by Cardiff's trees

Air pollution removal: trees remove airborne pollutants including Nitrogen oxides, ozone, carbon monoxide and particulates (PM_{2.5}). These pollutants have negative health impacts, including shortness of breath, respiratory tract irritation, and loss of life. Cardiff's trees remove the equivalent of 10.5% of PM_{2.5} emitted from transport in Cardiff each year.

190 tonnes
of airborne
pollutants
removed each
year

worth
£940,000
annually

Avoided stormwater runoff: trees can help prevent surface runoff and the risk of flooding by intercepting rainwater, retaining it on their leaves and absorbing some into their tissues. They also ease drainage into and through the soil, reducing the volume of water entering water treatment works. This is especially important for the 12% of Cardiff's population that is at risk from extreme flooding events.

356 million litres
of rainfall
intercepted each
year

worth
£476,800
annually

Carbon storage and sequestration: trees are an important repository for carbon. By absorbing carbon dioxide from the atmosphere trees help to combat climate change. Larger tree species store more carbon than smaller trees. They also tend to live longer, providing a long-term carbon store. The annual net sequestration rate of Cardiff's trees is equivalent to the annual emissions from 14,067 cars.

321,000 tonnes
of carbon stored

worth
£76.6
million

7,900 tonnes
sequestered
each year

worth
£1.9
million
annually

Annually, Cardiff's trees provide ecosystem services worth £3.31 million.

This estimate is based on annual values for air pollution removal, avoided stormwater runoff and carbon sequestration only. It is therefore an underestimate of the total value of benefits which urban trees provide.

CAVAT: Replacement value

The public amenity asset value of Cardiff's trees was calculated at **£11.2 billion**.

This value, calculated using the CAVAT (Capital Assessment Value of Amenity Trees) Quick Method, reflects the costs to replace every tree in Cardiff. Valuation considers tree stature, condition and remaining lifespan.

The single most valuable tree surveyed was a beech with an estimated CAVAT value of **£95,554**.

Pest and disease resilience

The risk from key threats is shown in Fig. 6 as a proportion of the total CAVAT replacement cost of Cardiff's trees. The red bar indicates threats already present in Cardiff whilst the orange bars are threats from significant pests and disease not currently present. Ash is the species at highest risk from disease, and as the single most populous species in Cardiff raises concerns for potential loss in canopy cover and ecosystem service delivery.

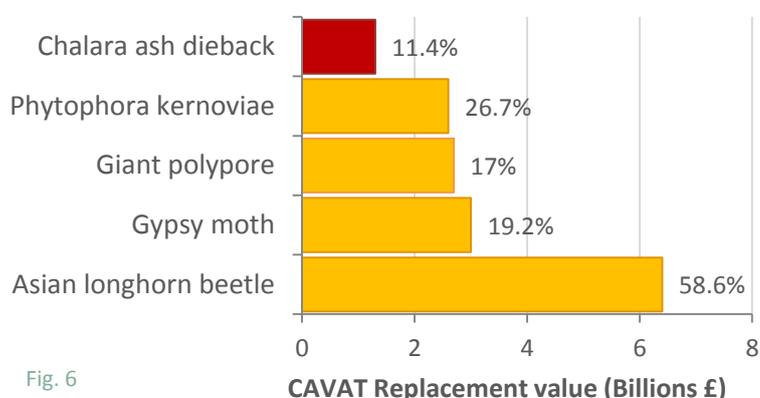


Fig. 6

Asian longhorn beetle threatens the greatest proportion of Cardiff's tree population. If an outbreak were to occur in the UK and reach Cardiff some of the city's most populous trees would be affected including sycamore, beech, hazel, birches and alders.



Key findings

Canopy cover is high, but may be threatened.

Canopy cover is higher than many other coastal cities, but much of this is due to surrounding rural area inclusion in the study boundary. These high canopy areas may be under threat from new development.

Canopy cover is unequally distributed.

Most of the canopy cover is within the north of Cardiff, which tended to have more trees in private ownership. The south of Cardiff (incl. the city centre) has higher population, but receives fewer benefits from having fewer trees.

What's next?

i-Tree Eco studies are a first step towards delivering a more sustainable and valuable urban forest. The findings can provide a base for setting new management targets, identify threats and inform strategic planting to improve benefit provision.

In other cities, i-Tree Eco studies have provided the quantitative evidence to develop new urban forest strategies, raise the profile of urban trees and make the case for investment in urban trees.

Cardiff is dominated by two tree species.

Ash and sycamore compose over 20% of all Cardiff's trees. Dominance by a small number of species can increase the urban forest's vulnerability to climate change and pest and disease outbreaks.

Cardiff could have more large trees.

Cardiff had a high proportion of large trees (> 60 cm dbh) relative to other studies, but less than the recommended 10%. Increasing the number of large trees would deliver greater benefits to Cardiff.

Recommendations

Identify priority areas for new tree planting: NRW's (2016) ward-level canopy assessment revealed high variation in the distribution of canopy cover across Cardiff. Reviewing canopy cover with indicator statistics (e.g. Welsh Index of Multiple Deprivation, building density) could help to identify opportunities to improve benefit delivery through increasing canopy cover in the areas of greatest need.

Develop tree planting strategies: Urban environments and warming climates pose many challenges to trees. Selecting tree species for future planting schemes that are suitable to the current and future environment of Cardiff is crucial to developing a healthy urban forest.

Protect the existing tree resource: Supporting and retaining existing urban trees is essential to preventing declines in canopy cover and the loss of benefits. Tree Preservation Orders require regular review to make sure all trees worthy of preservation are protected and that re-planting is carried out where necessary. Furthermore, raising public awareness about the value and importance of trees will lead to greater protection through civic engagement.

Develop an urban forest masterplan: An urban forest masterplan could define a strategic vision for Cardiff's urban forest, set key actions and ensure these are implemented and monitored. Objectives for the masterplan may include:

- Describe the nature and extent of the urban forest and provide a vision for the future;
- Set out an action plan to deliver this future, including specific targets for monitoring progress. Key targets could include canopy cover increase within particular land-uses such as within new developments;
- Set ambitious targets for cooperative; development of the urban forest together with, for example, communities, local business and utility companies;
- Identify and prioritise action through planting and management to ensure that tree cover is maintained, sustained and improved;
- Describe the role of trees within Cardiff's landscape, such as in a Landscape Design Plan;
- Develop a set of principles, standards or policies relating to urban trees that can be used to guide the design, development, and deployment of services delivered by Cardiff's urban trees.