Valuing Southampton's Urban Forest: A Summary Report

This report summarises the first comprehensive study on Southampton's urban trees. The study utilised i-Tree Eco, a software tool used worldwide to assess and value urban forests to inform their management.

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

Vulnerabilities in Southampton's urban forest were highlighted, including poor condition of trees, over-reliance on certain species and the risks from pests and diseases.

The information provided in this study offers a platform for Southampton to tackle these vulnerabilities, make informed decisions and set targets to manage its urban forest to improve its resilience and delivery of benefits.

Southampton has an estimated 267,000 trees covering 18.5% of the city

Southampton's trees provide benefits worth £1.29 million annually to those who live and work in the city

The replacement cost of Southampton's trees is £3.2 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.

Southampton is a city with one of the fastest growing populations in the UK, generating a pressure on the urban forest as well as a greater need for the benefits it provides. Urbanisation is associated with particular detriments to a city's sustainability and liveability, including high pollution levels, risks of localised flooding and contributions to climate change. Additionally, urban residents can become isolated from nature and experience a deficit of access to greenspaces, linked to poorer physical and mental health. Urban forests are an attractive natural means to help address these issues

i-Tree Eco is a respected model developed by the Forest Service in America and now used around the world. It allows for the quantification and valuation of urban trees. It is based on peer-reviewed research and in the UK it has been used to assess urban forests in 18 towns, cities and parks since its pilot in Torbay in 2010.

This study provides new evidence to support and deliver Southampton's agenda to develop a sustainable and liveable city using green infrastructure, as proposed in policies including the Southampton Council Strategy (2016-2020), City Centre Action Plan (2015), Southampton Local Flood Risk Management Strategy (2014-2019) and Low Carbon City Strategy (2011-2020).

Study aim: To provide an evidence base to inform management of Southampton's urban forest and to help Southampton meet social, economic and environmental objectives.

Forest Research

Treeconomics

University of Southampton

Southampton City Council

Methods

In the summer of 2016, data on urban trees was collected from 414 plots randomly allocated across Southampton city, a study area of 5,019 ha. Data collection followed standards described within the i-Tree Eco v6 manual. Information collected included tree species, trunk diameter, height, crown size, condition, shading and land-use.

The data was entered into i-Tree Eco to describe the composition and structure of Southampton'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: 2016 DECC value of £63 per tonne.
- Avoided runoff: avoided water treatment metered charge rate of £1.310 per m^3.
- 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: Southampton has an estimated canopy cover of **929 ha**, covering **18.5%** of the city area. This is greater than canopy cover reported in the Torbay (12%), Inner London (18%), Tawe catchment (16%) and Edinburgh (17%) i-Tree Eco studies.

Ownership:

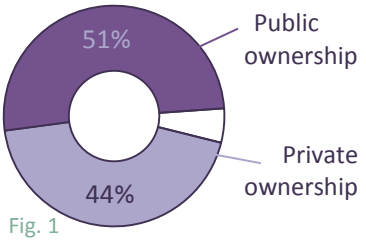


Fig. 1

Tree type:

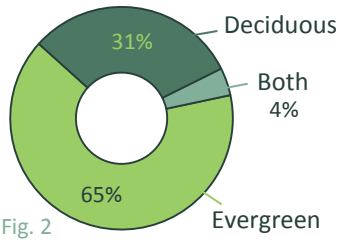
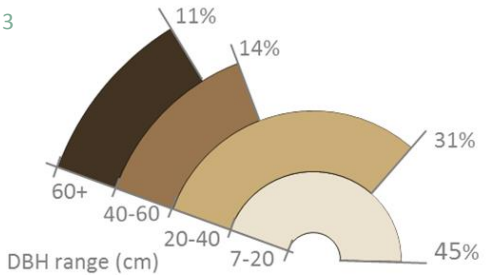


Fig. 2

Tree population: The estimated tree population of Southampton was **267,500**. This is approximately one tree per city resident, or an average of 52 trees per ha.

Structure: Trunk diameter can be related to ecosystem service provision, with older larger trees providing more services such as amenity value and biodiversity. Fig. 3 shows the size distribution of Southampton trees; few were greater than 60 cm diameter.

Fig. 3



Composition: A tree population with a diverse range of tree species is more resistant to pests and diseases.
A total of 103 species were identified in this survey. Diversity of species in Southampton is good, although English oak and sycamore exceed recommendations that no species should compose more than 10% of the population. The proportion of the most common species within the urban forest are displayed in Fig. 4.

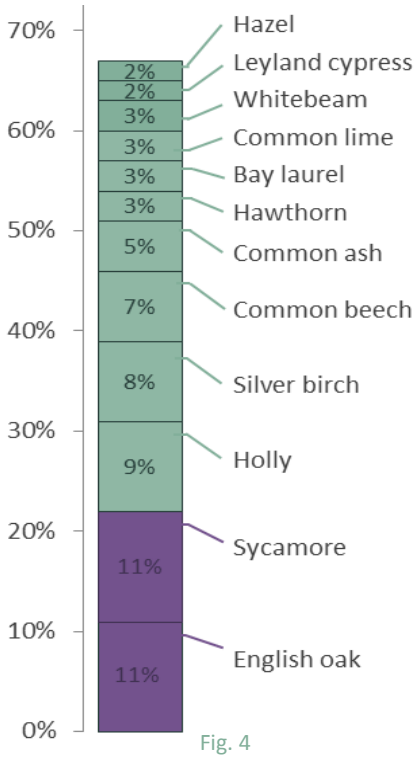


Fig. 4

Condition: 9% of Southampton's trees were in excellent condition, lower than recorded in other i-Tree Eco studies. The proportion in each condition category is shown in Fig. 5

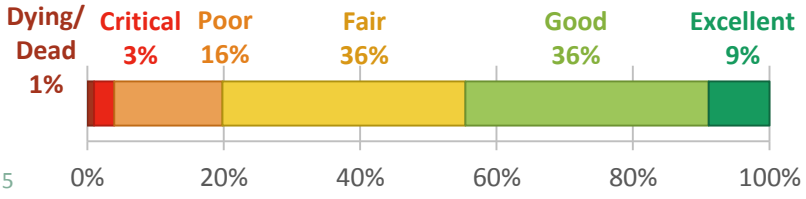


Fig. 5

Ecosystem services provided by Southampton's trees

Air pollution removal: trees remove airborne pollutants including NO_2, O_3, SO_2, CO and $PM_{2.5}$.These pollutants have negative health impacts, including shortness of breath, chest pain and respiratory tract irritation. Long-term exposure can be life-threatening. This is a significant threat to Southampton residents, where air quality levels have been recorded below EU standards.	**90,000 kg** of airborne pollutants removed each year, worth **£534,000**
Avoided stormwater runoff: trees can help prevent surface runoff 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 and the risk of flooding. Sycamore, oak and beech provided the greatest stormwater interception service relative to their proportion within Southampton's urban forest.	**95 million litres** of rainfall intercepted each year, worth **£144,000** annually in avoided water treatment costs
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 Southampton's trees is equivalent to the annual emissions from 330 households or 101 million miles driven in a car.	**100,600 tonnes** of carbon stored, worth **£23.4 million**, and **2,700 tonnes** sequestered each year, worth **£609,000**
Annually, Southampton's trees provide ecosystem services worth:	**£1.29 million**

CAVAT replacement cost: £3.2 billion

The CAVAT value represents the cost to replace trees, incorporating their health and contribution to amenity. Larger stature tree species held the greatest CAVAT values in Southampton. In particular, oaks (*Quercus*) were valued at £655 million, maples (*Acer*) at £522 million and pines (*Pinus*) at £238 million. The most valuable tree was a common lime, valued at £257,550. The land-use containing the highest CAVAT value of trees was Parks (51%); vacant (or brownfield) land also held a significant proportion (9%).

Pest and disease resilience

With severe pest and disease outbreaks such as Dutch elm disease occurring within living memory and climate change making it easier for some pests and diseases to survive in the UK, assessing the risk from these to urban forests is of paramount importance to promote long-term security.

The risk from selected threats is shown in Fig. 6 as a proportion of the total CAVAT replacement cost of Southampton's trees.

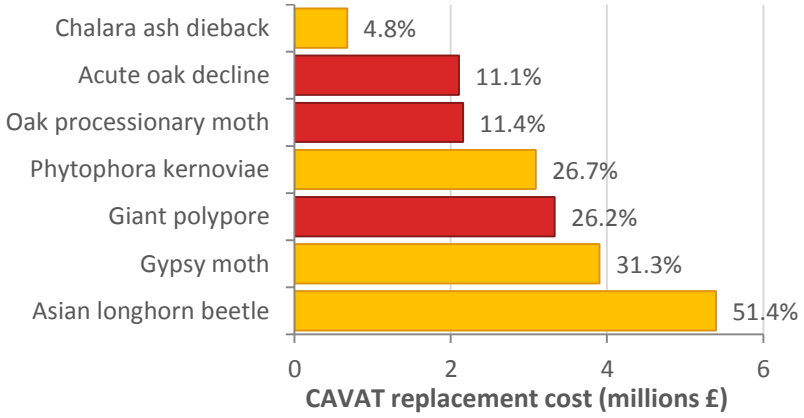


Fig 6. Replacement cost of trees threatened by key pest & diseases

Red bars are threats already present in Southampton; orange bars are threats from significant pests and disease not currently present. Oak and ash, two of the most common species in Southampton, are identified as particularly vulnerable, representing a potentially significant loss in ecosystem service benefits provided.

Key findings and recommendations

Southampton's urban forest is a valuable asset to the city and its residents. i-Tree Eco values only a subset of the benefits provided by trees. Thus, the annual provision of services valued at £1.29 million is an underestimate of the total value of Southampton's urban forest. The quantity and value of ecosystem services provided can be improved by increasing Southampton's tree canopy cover.

- **Increasing street tree planting, making tree planting mandatory on new developments and protecting existing trees can help Southampton achieve its target to increase canopy cover from 18.5% to 25%.**
- **Assessment of the urban forest should be repeated in five years to monitor changes and progress of management strategies towards future targets. Use of i-Tree Eco for this re-assessment will ensure comparability.**

The diversity of tree species in Southampton is generally good, although improving diversity would improve resilience to pest and disease outbreaks. For example, oaks are the most common species in Southampton and provide a disproportionate amount of the ecosystem services, yet they are also one of the groups at highest risk from pests and diseases.

- **Planting a wider variety of trees to broaden the species assemblage in Southampton will reduce the likelihood and impact from a pest or disease outbreak.**
- **Species selection should consider both resilience to pests and diseases, and adaptability to future climate change to maximise future tree survival.**

Larger trees (>60 cm diameter) are under-represented in Southampton. Larger trees provide greater volumes of ecosystem service provision, and a diverse age structure is important to support urban forest resilience.

- **Protecting existing mature trees will help maintain the value of Southampton's urban forest. Many large stature trees were found on vacant land, development of such land should aim to preserve these trees where possible.**
- **Setting a preference for the planting of large-stature trees, where appropriate, will increase total ecosystem service provision.**

The benefits provided by Southampton's trees contribute to the delivery of local and national policies, including climate change adaptation, and improvements in air quality and the well-being of the people of Southampton

- **Strategic planting of tree species should be targeted to help alleviate the problems associated with urbanisation, such as using large stature tree species as part of Sustainable Urban Drainage Systems (SUDS).**

The condition of Southampton's trees was found to be poorer than in other i-Tree Eco studies, with only a small number of trees in excellent condition.

- **Assessing the causes of poor tree condition is required to action changes to improve the health of Southampton's trees. This will help build a more resilient and productive urban forest.**

What next?

i-Tree Eco studies are a first step towards delivering a more sustainable and valuable urban forest. Information presented here can be used as a base for setting new management targets, identify threats in need of pro-active management, and inform strategic planting to improve eco-system service provision.

In other cities, i-Tree Eco studies have provided the quantitative evidence to demonstrate the monetary value of trees. This has helped raise the profile of urban trees and make the case for investment. Integrating the results into a fully revised and updated tree strategy can help develop a proactive approach to tree management and identify specific targets to improve the urban forest and contribute to wider policy targets.

This study shows urban trees already contribute to Southampton's policy agenda including climate change adaptation, improving air quality and improving well-being of city residents. The information here can be used to make trees part of the discussion of how better to tackle these problems.