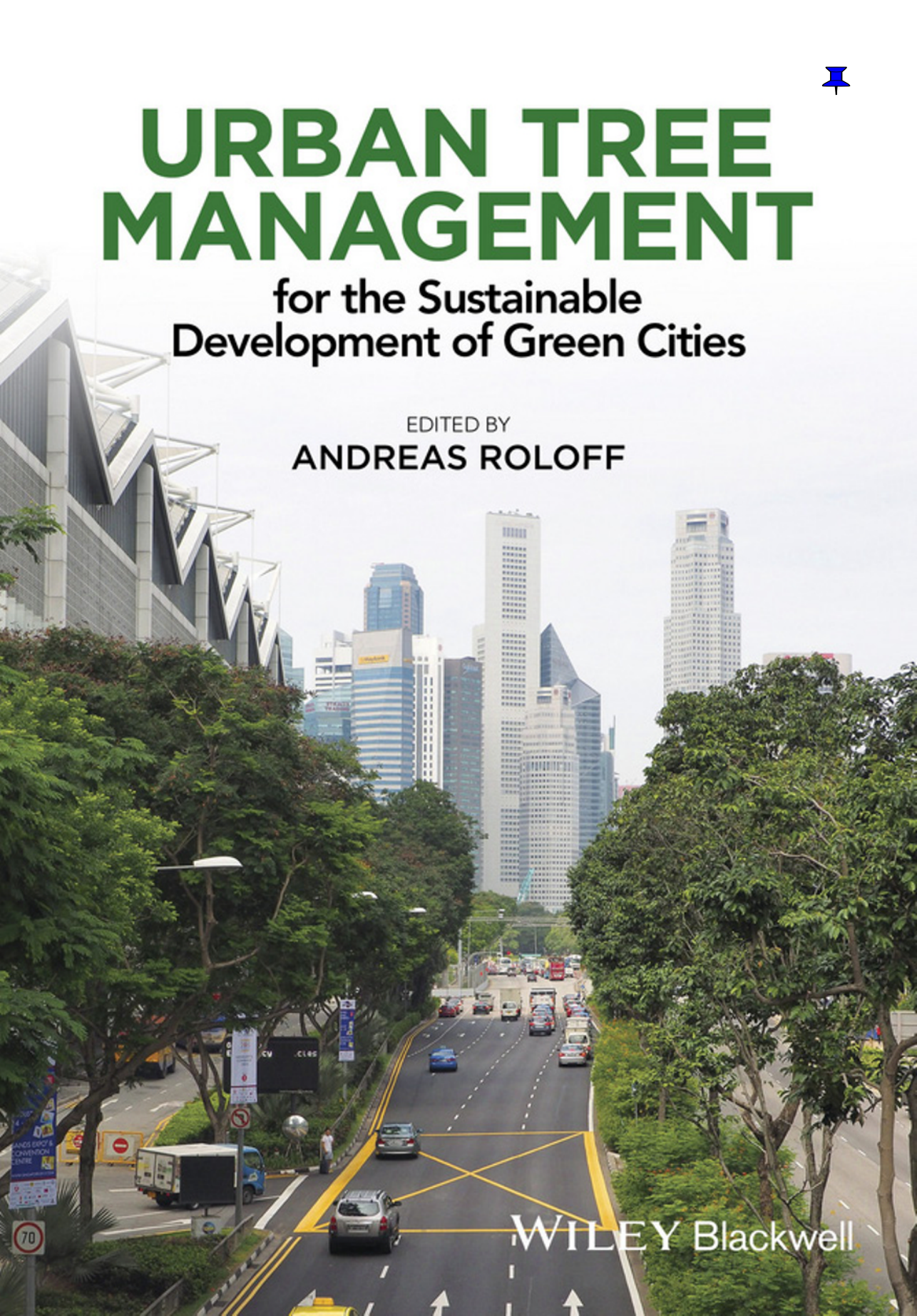
URBAN TREE MANAGEMENT

for the Sustainable Development of Green Cities

EDITED BY

ANDREAS ROLOFF



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CHAPTER 1

Intro: Urban trees – Importance, benefits, problems

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1.1 Introduction

Trees often and quickly gain a bad reputation, caused by falling branches or entire trees, roots in sewage drains, neighbors fighting over fruit and leaves littering their gardens, health issues from pollen allergies, etc. The problems caused by city trees are usually more conspicuous and have greater ramifications. Their advantages can often be difficult to record and to assess. As a result, the negative impacts are much more widely discussed, whereas extensive papers about their positive aspects are rare.

This chapter, therefore, aims to raise awareness of the positive impacts and benefits of urban trees and their importance to city dwellers (Figures 1.1 and 1.2). It describes their advantages (with no claim to completeness) and details their effects on our quality of life and well-being – aspects that are increasingly important in these times of progressing urbanization.

> *"If I knew the world would end tomorrow, I would still plant another tree today."*
>
> – Martin Luther

1.2 Aesthetics, sensory impressions

To many people, the *beauty of nature* is manifest in trees (Tyrväinen *et al.*, 2005). This is especially true for ancient, free-standing trees. Their variation in phenology (change of appearance across the seasons), including shooting, blooming, fruit, leaf coloring and falling leaves, is an important factor in how we *experience the seasons*, especially in cities. Many trees even change their smell over the course of the year. Areas without trees can be areas without seasons, especially in temperate climates.

Visual impressions such as coloring (e.g., of the leaves in spring and autumn), different structures (e.g., the shape of the leaves and the architecture of the treetops), design (e.g., Lombardy poplars, ancient oaks) and aesthetics (how a tree affects us) cause positive emotions and experiences (Bahamón, 2008; Miller, 2007; Trowbridge and Bassuk, 2004; Smardon, 1988; Velarde *et al.*, 2007). As an example of the *aesthetic impact* of different tree species, just think of a light, young grove of birches, as opposed to a dark, dense forest of conifers in spring. An assessment based on aesthetics is, of course, subjective, but it may still be used, for example, to rank city trees by popularity.

Urban Tree Management: For the Sustainable Development of Green Cities, First Edition. Edited by Andreas Roloff.

Figure 1.1 Treeless square – cold, hard, unwelcoming, and easily overheated in summer.

Figure 1.2 Square with trees (*Fraxinus angustifolia*) – segmented, warm, inviting and shady.

Aside from visual impressions, the senses of smell (blossoms, autumn leaves), hearing (rustling of the treetops, rustling of the fallen leaves), taste (fruit, young leaves) and touch (fruit, young leaves) also play important roles.

1.3 Psychology, well-being, health

Trees accompany us through life. Relationships between trees and people are complex and have been poorly investigated. The potential of such relationships becomes clear if you consider the "*house tree*". Even today, it is not uncommon for families to plant a tree next to their home – for example, to serve as a "patron", in order to have shade in summer and shelter from wind, or in order to grow fruit, honey, and so on (Figure 1.3). Some house trees are even considered a member of the family, and the bond is particularly strong if the tree was planted by the owner of the home to mark a special occasion. Positive feelings towards house trees are usually associated with aesthetics: "looks nice"; "the blossoms"; "the color of the leaves". Gardens often contain many of the "public" trees along the streets and in the parks of a city. In Dresden, for example, there are 600,000 private garden trees, but only 60,000 public street trees (Roloff, 2013).

Trees are also increasingly important for our health – for instance, visits to parks (municipal, spas and civic parks) and gardens, walks and hikes, resting on a bench under a tree, picnics in

Figure 1.3 House tree (*Acer pseudoplatanus*) – often a member of the family.

Figure 1.4 Relaxing under a tree (*Castanea sativa*) in a park in Cornwall, UK.

the shade of trees (a popular custom in many cultures). Parks may therefore also be called "therapeutic landscapes", and a movement called "garden therapy" is currently on the rise. Gardens (including allotments) are increasingly seen as personal spas, as a place where people can feel comfortable and relax – gardening as private health care.

In addition, city trees also protect us from *emissions*, especially by reducing the levels of ozone, nitrogen oxides, sulfur and carbon dioxide (Harris *et al.*, 2004; Konijnendijk *et al.*, 2005; Tyrväinen *et al.*, 2005; Yang *et al.*, 2005; Donovan *et al.*, 2011). Parks act as a city's "green lungs". In recent years there have been many discussions about *particulate matter* and how it can be reduced to protect our health, with a focus on the ability of trees to bind microparticles in their leaves. Benefits from this depend on factors such as the placement of the trees along the streets, and the width of the streets (see Chapter 13).

Due to their positive impact on our psyche and health (Harris *et al.*, 2004; Konijnendijk *et al.*, 2005; Tyrväinen *et al.*, 2005; Arnberger, 2006; Hansmann *et al.*, 2007; Carreiro *et al.*, 2008; Konijnendijk, 2008; Miller, 2007; Velarde *et al.*, 2007; Cox, 2011; Lee and Maheswaran, 2011), and because they have been proven to accelerate recovery and regeneration, trees often dominate the parks that belong to spas, asylums, or hospitals, as well as cemeteries. They also provide the shade needed in summer, they reduce noise and improve the quality of the air, and they have a calming effect on the mind (see Figure 1.4) (Harris *et al.*, 2004; Tyrväinen *et al.*, 2005). Parks are also popular places for physical activities (ball games, walking, running, etc. – Lohr *et al.*, 2004; Matsuoka and Kaplan, 2008). Recent research shows the importance of nature for the living environment and local recreation; nature is

Table 1.1 Psychological, physical and social benefits of being and exercising in urban parks.

Psychological benefits	• being close to nature brings us closer to our own nature • increased relaxation and well-being • reduced stress levels • anti-depressant effects of light and greenery
Physical benefits	• from physical activities (walking, exercising, etc) • increased energy from cool and fresh air • stimulation of all the senses • increased cognitive performance
Social benefits	• stimulation of interaction, especially between children and adults, or between different cultures • increased feeling of belonging, reduced social isolation • increased feeling of responsibility due to consideration of natural interrelations.

seen as the most important factor. The physical, psychological and social benefits of being and exercising in green areas (e.g., in parks and gardens) are summarized in Table 1.1.

Trees can also have a lasting influence in childhood, for instance by forming a local identity; a tree species that dominated our surroundings in childhood is usually associated with fond memories, and we may love it for life. *Tree adoptions* are a popular gift, and usually result in a personal relationship between the presentee and the tree or the tree species. Planting a *birth tree* at the birth of a child used to be common practice (and is becoming popular again). In the 18th century, many places had a law that a wedding license would only be granted if a certain number of young, verdant *wedding trees* had been planted. Wedding avenues and dummy trees (to help children wean off their pacifiers – see Figure 1.5) are examples of modern customs associated with trees.

In past times, *dance and court trees* used to be very important. Dance lindens had a platform in the crown where dances were held; court lindens were used for meetings dedicated to law and order. The finding of justice was based on the belief that nobody would dare lie under a *Tilia* tree.

Maypoles are tall, pruned and decorated trees that are raised as part of a festive celebration in a central place in the town. A *roofing ceremony* is a celebration under a tree that is attached to the roof when the shell of the building has been completed (Figure 1.6).

Trees are also central in *landscaping*, such as in the planning and construction of parks, squares, private and landscaped gardens. A park that resembles a savannah (Figure 1.7) is particularly beneficial for humans. It accommodates our primal urge for keeping everything in sight, which originates from the prehistoric development of humankind in the African savannah. Looking at trees and shrubs gives us pleasure. Trees can create a certain ambiance (e.g., potted palm trees for a tropical flair).

The psychological aspects of the relationship between people and trees are particularly noticeable in tree-based *horoscopes* (e.g., the "Celtic tree horoscope"). These use certain tree types, depending on their appearance (e.g., *Quercus* for toughness, *Pinus* for pickiness, *Salix* for melancholia).

Because ancient, giant specimens have always awed humans, trees also play an important role in mythology. Trees are the most suitable image to represent humanity, because they, too, stand tall and raise their "arms" toward heaven ("Trees are like brothers"). Many religious scriptures have tree allegories, and many sayings also use the simile of tree and human, e.g., "a bad tree does not yield good apples" or "the apple doesn't fall far from the tree". Many places have sacred woods.

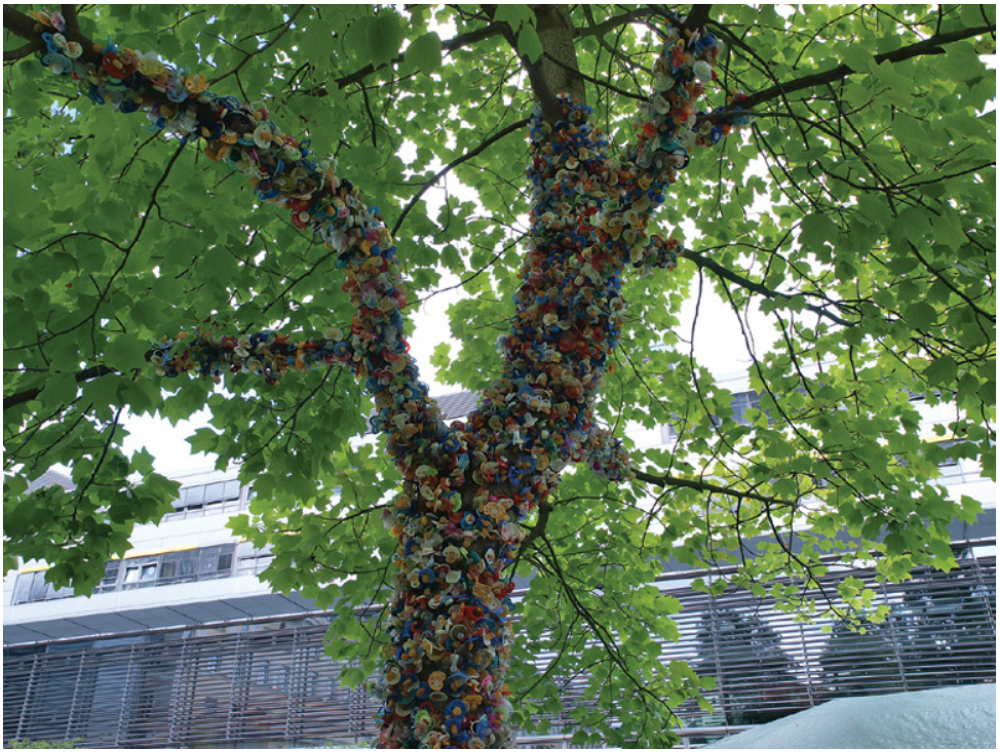

Figure 1.5 Dummy tree (*Liriodendron tulipifera*), to help children wean off their pacifiers.

Figure 1.6 *Betula pendula* tree in a roofing ceremony – a decoration very popular in house building.

Figure 1.7 A park that has been landscaped to resemble a savannah, including stretches of lawn with individual trees and edges of woods.

Aspects of ancient religions often revolve around trees, such as the "tree of forbidden knowledge" at the beginning of the Bible, when Adam and Eve are expelled from Paradise after eating its fruit. Other examples are the giant ash Yggdrasil in Norse religion, or Buddha's Tree of Enlightenment. Even today, the symbolic and spiritual importance of trees can be deduced from the coins of many countries that show trees or leaves. *Songs, literature, poetry and fairy tales* often revolve around trees. Many ancient stories tell of people who are turned into trees.

Last, but not least, there are trees that are very special. In Germany there is one that is very special for relationships – an old *Quercus* tree, close to the village Eutin (north of Hamburg), called the "Flirt tree". It is the only tree in Germany that has its own postal address and its own "letterbox" (a hole in the trunk; Figure 1.8) – exempt from the sanctity of mail. People write to the tree about their wish for a partner, husband or wife, or read and respond to the letters left in the tree by others.

Aging in trees is usually seen as something positive; the older a tree, the bigger the impression it makes. Ancient trees represent birth and decline, give us a feeling of timelessness and connect us with past eras (Luther's *Tilia*, Goethe's *Gingko*, Newton's apple tree – Stokes and Rodger, 2004). At the same time, they make us aware of the modest role and lifespan of the individual person. Trees create an atmosphere of piece and quiet, thus helping us to *relax and improving our moods*. City dwellers in Michigan, USA, said in a survey that trees are the strongest contributing factor for the attractiveness of streets and districts (Figure 1.9), whereas their absence was the most negative factor: "Streets without trees have no face."

Figure 1.8 The "letterbox" of the "Flirt tree" (*Quercus robur*), used for searching for a partner.

Figure 1.9 Road-side trees (*Acer platanoides*) with a strong positive effect on the quality of living.

Color psychology studies the effect of colors on the psyche. According to its position in the chromatic circle, the green of leaves has a balancing and calming effect. It induces harmony, inspires, stabilizes, improves our self-esteem and makes us yearn for (the lost) paradise. This is another reason why woods and parks have such a relaxing effect on us.

Green is particularly beneficial for people who are prone to mood swings. Going for a walk in the forest or the park usually has great a very positive effect on people with depression. Green is also the color traditionally used by environmentalists, because it represents life and a healthy environment.

The so-called "*Tree test*" – the interpretation of spontaneously drawn tree pictures – has been a much-used (albeit controversial) method in psychotherapy for finding causes for abnormal behavior in children and adolescents. Therapists analyze the centre of gravity and the crowning height of the tree, as well as peculiarities in the rendition of trunk, crown and roots.

1.4 Environmental education, ecology

Trees are essential for encouraging *environmental awareness* in cities. City dwellers are increasingly alienated from nature, but trees allow them to experience a small measure of wilderness and of the wonders of nature by realizing the principles of adaptation, optimization and sustainability (Kowarik and Körner, 2005; Miller, 2007; Konijnendijk, 2008; Hofmann *et al.*, 2012), and by changing and reacting in the course of the year (and over the years). They also play an important role in the environmental education of children. Proof of this are the many recently established forest kindergartens.

Trees contribute to *biodiversity, conservation of nature and preservation of genes* (Tommasi *et al.*, 2004). Moreover they form the habitat for birds (e.g., jay), insects (e.g., longicorn), mammals (e.g., squirrel), epiphytes (e.g., mistletoe), fungi (e.g., tinder fungus), lichens (e.g., common orange lichen) and so on, and help to integrate and link biotopes across parks, green corridors or avenues.

1.5 Orientation, spacious ordering, architecture

Avenues and tree-lined streets and roads have been used for centuries (in some cases, even for millennia) for *orientation and guidance*. They direct the eyes or show the way (e.g., toward important buildings or prominent locations), increasing road safety at the same time.

Trees also contribute to the *enhancement, structuring and design* of public open spaces by separating them into individual, yet not entirely disconnected areas, increasing the impression of space (Figure 1.2). Ancient trees in squares and significant places in towns and cities are often a decisive factor in *forming the townscape*, as can be seen in place names such as "Royal Oak", "Elm Tree" (also common pub names) or "Hollywood". Such markers are often protected as natural monuments; in some cultures, they are even considered sacred (e.g., in China).

In (landscape) architecture, trees have long been used for purposes such as directing the view, for emphasizing the shape and style of buildings, as a framework, as a contrast, for creating a connection to the gardens or the surrounding landscape (e.g., in Singapore), and also in their role as house trees.

1.6 Protection, quality of life

Trees are currently gaining great importance in *local climate protection*, as rising temperatures make their role in providing shade and increasing humidity (by transpiring) more and more relevant (Harris *et al.*, 2004; Heidt and Neef, 2008; Konijnendiek, 2008;

Figure 1.10 Desired shading by urban trees (*Liquidambar styraciflua*) on a hot summer day.

Bowler *et al.*, 2010). City trees equalize extreme temperatures. They contribute to cooling and shading (Figure 1.10), which is perceived as pleasant. While temperature differences between parks and areas covered by buildings or concrete may be measured at up to 5°C, the perceived difference in physiologically equivalent temperature (PET) is usually much higher and may reach more than 10°C (due to the increased humidity under trees). The difference in surface temperature between asphalt and tree-covered greens is even more extreme (up to 15°C).

The density and surface area of the leaves is, of course, an important determining factor in this, and individual trees are far less effective than groves and woods. Every unit of LAI (Leaf Area Index, measuring the density of the foliage) reduces the surface temperature of the shaded area by approx. 1°C on hot summer days (Hardin and Jensen, 2007).

Current discussion about global warming assigns additional importance to trees because they are able to *fix carbon dioxide*. This may be relevant not only on a local scale for calculating the carbon footprint of a plot of land or of an entire city, but also on a global scale for scenarios of further global warming.

In *noise protection*, trees are important not only because of the objectively measurable reduction of noise by up to 10 dB, but also because of their psychological effect; they block traffic from view, which makes the reduction of the noise feel greater than it actually is (Bucur, 2006; Miller, 2007). How efficiently a treetop works as a *screen* depends on the tree's age and on the LAI (Leaf Area Index) of its species. Dense branching with a great number of small leaves is particularly effective (see Chapter 13).

Trees also provide good *shelter from wind* (Coutts and Grace, 1995; Harris *et al.*, 2004; Trowbridge and Bassuk, 2004). In windy regions, it is therefore common to plant and cultivate rows of trees (e.g., along cycle paths). For free-standing houses, protection from wind is one of the most important capacities of house trees; in damp or wet isolated locations, they are also important as *protection from lighting*.

In *bioengineering*, trees (especially willows and alders) are important as slope protection and for erosion control. In densely populated areas, trees contribute significantly to *water pollution control*, rain water retention, and flood control (e.g., in spring reserves).

1.7 Food/diet, healing powers

Pomaceous fruit (e.g., apples, pears, cherries, peaches) and nuts (e.g., hazelnuts, walnuts) are an *integral part of our diet*. Their advantage is that, with regards to pathogens, trees are at a far lower risk than agricultural crops. In addition, they usually do not deteriorate the soil, and so do not require fertilizing. Mushrooms should also be mentioned in this context – many species are mycorrhizal fungi, and therefore depend on trees.

Some species are important for bees, and are thus involved in the production of honey. Leaves can be used to make tea (e.g., camellia). Connoisseurs also use them in salads. Leaves were also traditionally used (and still are) as fodder.

Many tree substances have *medical benefits* that still play a very important role in many cultures. Phytotherapy (botanical medicine) uses both traditional tree supplements (e.g., gingko substances for improving blood circulation) and new discoveries (e.g., cancer treatment based on yew substances) (Clarke, 1996).

1.8 Utilization of trees

Children like building *tree houses* and use horse chestnuts and acorns for making figurines. *Playgrounds* and gardens often boast trees for climbing and swings.

Wood is used to make furniture and utensils or is used just as firewood. Leaves and bark can be used to dye natural materials. The spring sap of maples (especially sugar maple) can be made into syrup (maple syrup) and is an important ingredient for pancakes, ice cream and other dishes; the spring sap of birches can be used for hair tonics; the bark of cork oaks is used as an insulating material and for corking bottles.

Mention must also be made here of the *Christmas tree*, which has been a popular custom in many countries for 500 years.

1.9 Economic and social advantages

Trees are an *economic factor*, because people prefer green cities and districts. However their advantages are difficult to calculate from an economical and monetary perspective (Schulz and Balder, 2000; Price, 2003; Harris *et al.*, 2004; Konijnendijk *et al.*, 2005; Miller, 2007; Carreiro *et al.*, 2008; Konijnendijk, 2008). In order to get a rough idea of the value of the advantages of city trees, compare them to appropriate substitutes:

- fruit crops vs. supermarket fruit;
- shading from trees vs. parasols or blinds;
- trees screening people from view vs. fences or walls;

- the cooling effect of foliage vs. air conditioning (Figure 1.10);
- air purification by trees vs. technological filters.

The economic value of trees for the United States, for example, has been estimated at 3.1 billion Euros per year, based on their emission control alone. The relationship between costs and benefits of city trees was calculated for two Californian cities, with cost/benefit ratios of 1.8 and 1.5 – an interesting result that clearly shows that the advantages prevail (McPherson and Simpson, 2002; Nowak *et al.*, 2006). Real estate agents often use proximity and the availability of green areas for advertising. Trees, especially older trees, can even *increase property value*. Mansions are incomplete without an older tree population. City trees also have an indirect economic value, such as in beer gardens or open-air restaurants, or for tourism.

In East Asia, it has been popular for a long time to exercise or meditate together in parks, as part of the morning relaxation ritual. The concept of the "*green gym*" is spreading rapidly all over the world. The same development is happening with guerrilla gardening; the planting of plants and trees in city centers by private people at their own cost. City dwellers want to experience more of nature in the city, together with like-minded people. At the same time, they can do something beneficial for themselves and for *urban greening*. This attracts young and old, rich and poor, and brings them together.

Parks in problem districts are especially suited to this type of physical activity, as it helps reduce prejudices against "the others", and participants from the area become increasingly conscious of the value of "their" green area. Intercultural exchanges and acceptance also benefit. Public woods and parks therefore provide a socio-cultural dimension by combining cultural processes and social networks (Harris *et al.*, 2004; Konijnendijk *et al.*, 2005; Tyrväinen *et al.*, 2005; Sanesi *et al.*, 2006; Heidt and Neef, 2008; Konijnendijk, 2008; Secco and Zulian, 2008; Sugiyama and Thompson, 2008). The provision of places for social interaction brings *social advantages*: meetings and events such as picnics with friends, a concert in the park or a cherry blossom festival; chance encounters on park benches; or when taking a pram for a stroll or a dog for a walk.

1.10 Issues

Finally, we would like also to mention the well-known and much-discussed negative issues that may be caused by urban trees, for example because of:

- fruits, leaves;
- vine lice, resin;
- pollen (allergies);
- falling branches;
- falling trees;
- undesired shading in summer;
- damage to pipelines from roots;
- damage to buildings from roots;
- bird droppings;
- raised cobblestones;
- accidents with trees (collisions);
- restrictions to building construction due to tree protection legislation;
- costs for tree maintenance;
- legal disputes (e.g., between neighbors).

These and other negative aspects must of course also be considered in an overall evaluation.

1.11 Conclusion

The results of such an evaluation may vary, depending on requirements, assessment and objectives. However, the positive aspects are always likely to prevail. The occasional inconvenience caused by trees should therefore be tolerated.

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