



The VALUE OF TREES: Making the Case for Tree Protection

Compiled by Barbara Heidenreich for the Ontario Urban Forest Council
www.oufc.org/ bh@fernhill.com updated January 2011

1.0 The Total Economic Value of Trees

Trees benefit us in many ways. We rely heavily on harvesting trees for our economic well-being. They provide timber for houses and furniture, cellulose for plastics and a vast range of products that enhance our lives. But living trees are essential to our existence, and not everyone knows this fact. It is often seen to be more “cost effective” to remove a tree that is in the way rather than accept it as a very important contributor to our quality of life. A “case” for preserving trees sometimes has to be made. Fortunately there is extensive research already undertaken in documenting the environmental, social and economic benefits of trees and nature. The broad range of benefits that trees contribute, sometimes known as the “total economic value (TEV)”, is provided in Table 1 and references are appended that offer more details as to the value of trees. The struggle to attach dollar values to all these benefits continues, and Section 3 provides some interesting statistics developed so far.

The services from trees are many:

- *Trees Produce Oxygen:* we could not exist if there were no trees. A mature leafy tree produces as much oxygen in a season as 10 people inhale in a year. The forest also acts as a giant filter cleaning the air we breath.
- *Trees Clean the Soil:* Phytoremediation is the term used for a tree’s ability to absorb dangerous chemicals and other pollutants that have entered the soil. Trees can either store harmful pollutants or actually change the pollutant into less harmful forms. Trees filter sewage and farm chemicals, reduce the effects of animal wastes, clean roadside spills and clean water runoff into streams.
- *Trees Control Noise Pollution:* Trees muffle urban noise almost as effectively as stone walls. Trees, planted at strategic points in a neighbourhood or around a house, can abate noises from freeways and airports.
- *Trees Slow Storm Water Runoff:* Flash flooding can be dramatically reduced by a forest or by planting trees. One mature spruce either planted or growing wild, can intercept more than 1000 gallons of water annually when fully grown. Underground water-holding aquifers are recharged with this slowing down of water runoff.
- *Trees Are Carbon Sinks:* A tree absorbs and locks away carbon dioxide in the wood, roots and leaves. A forest is a carbon storage area or a “sink” that can lock up as much carbon as it produces. This locking-up process “stores” carbon as wood and not as an available “greenhouse” gas.
- *Trees Clean the Air:* Trees help cleanse the air by intercepting airborne particles, reducing heat, and absorbing such pollutants as carbon monoxide, sulphur dioxide, and nitrogen dioxide. Trees remove this air pollution by lowering air temperature, through respiration, and by retaining particulates.

- *Trees Shade and Cool:* Shade resulting in cooling is what a tree is best known for. Shade from trees reduces the need for air conditioning in summer. In winter, trees break the force of winter winds, lowering heating costs. Studies have shown that parts of cities without cooling shade from trees can literally be "heat islands" with temperatures as much as 12 degrees Fahrenheit higher than surrounding areas.
- *Trees Act as Windbreaks:* During windy and cold seasons, trees located on the windward side act as windbreaks. A windbreak can lower home heating bills up to 30% and have a significant effect on reducing snow drifts. A reduction in wind can also reduce the drying effect on soil and vegetation behind the windbreak and help keep precious topsoil in place.
- *Trees Fight Soil Erosion:* Erosion control has always started with tree and grass planting projects. Tree roots bind the soil and their leaves break the force of wind and rain on soil. Trees fight soil erosion, conserve rainwater and reduce water runoff and sediment deposit after storms.
- *Trees Increase Property Values:* Real estate values increase when trees beautify a property or neighbourhood. Trees can increase the property value of your home by 15% or more.



Photo: Susan Trow



Photo: Barb Heidenreich

Table 1: TREES: Their CONTRIBUTION TO HUMAN WELL-BEING (Total Economic Value -TEV)

Direct Use Value based on consumption of the tree	or	Direct Use Value based on consumptive use without destruction	Non-Use Value & Indirect Use Value providing human benefits with no negative impact on the tree	
<p><i>Trees as an economic resource that have Direct Use Value and result in destruction of the tree or forest biome</i></p>		<p><i>Living Trees as a sustainable economic resource with benign extraction providing Direct Use Value, involving some consumption but not destruction of the tree</i></p>	<p><i>Social, cultural goods and services that contribute to human well being (Chiesura & de Groot 2003)</i></p>	<p><i>Ecosystem Functions and corresponding services that have Indirect Use Value</i></p> <p><i>(adapted from Costanza,R., D'Arge R., De Groot R., Farber S., et al. 1997;De Groot, R.S.. 2002)</i></p>
<p>Products consumed from timber, roots, bark and leaves:</p> <ul style="list-style-type: none"> • timber for construction, furniture, fencing etc • fuel as renewable energy • Christmas trees, specialty wood products (animal bedding, carvings, etc) • cellulose for the paper industry • silvichemicals from wood and bark: pharmaceuticals, neutraceuticals, cosmeceuticals, aromatherapy oils, herbal health products, fragrances • Oil and resinous tree metabolites as a by-product of wood pulping: tannins, terpenes, rosins and aromatic phenolic compounds. <p>As a dead tree, a source of coarse woody debris(CWD) Providing nutrients and microhabitats</p>		<p>Benign extraction of tree metabolites (resins, waxes, oils) for valuable chemical and bio-medical & pharmaceutical and personal care products - used for pest control or human health and personal care... methyl salicylate; vitamin C; neem,</p> <p>Genetic resources through biodiversity for new and wild relatives of existing plants;</p> <p>Tree fruit, tree nut and tree by-products for the production of commercial-industrial products: fruits, nuts, sap for maple syrup/sugar, rubber, palm oil; tree gum; holly foliage; cocoanuts; cork; shea nuts; browse for goats; non-timber forest products</p> <p>Recreation (active)</p>	<p>Health: sound abatement, restorative & behavioural benefits</p> <p>Aesthetic & Decorative & Spiritual</p> <p>Inspirational</p> <p>Social-Psychological values</p> <p>Cultural heritage: hedgerows, windbreak/shelterbelts</p> <p>Scientific – educational; Traditional Ecological Knowledge (TEK)</p> <p>Recreation (tourism & education): eco-tourism; canopy tourism; hiking trails; birding; photography</p> <p>Carbon credits</p>	<p>Gas regulation:– CO₂ / O₂ balance; UVb protection by ozone; maintenance of air quality;</p> <p>Climate regulation:- carbon regulation/sequestration, cloud formation;</p> <p>Disturbance prevention:– storm protection, drought recovery, flood control;</p> <p>Water regulation and water supply:– run-off control, filtering, water retention and storage;</p> <p>Soil retention and soil formation:- weathering of rock and decomposition of organic matter;</p> <p>Nutrient cycling:-storage, internal cycling, processing and acquisition of nutrients (e.g. nitrogen fixation);</p> <p>Waste treatment:-role of vegetation and biota in removal or breakdown of xenic and excess nutrients;</p> <p>Pollination:-role of biota in movement of floral gametes in wild species and crops;</p> <p>Biological control:-population and pest control by predator-prey dynamics;</p> <p>Habitat/Refugia:- suitable living and reproductive space for resident and migrating species</p>

2.0 Tools for calculating the economic value of trees:

Two software models UFORE and STRATUM have been developed and used to determine quantitative values of benefits of the urban forest less the costs of managing the forest.

2.1 UFORE (Urban Forest Effects Model): refers to a computer model that calculates the structure of the entire urban forest using sample plots and then the environmental effects of these trees such as their contribution to health by removing pollution from the air, by absorbing and sequestering carbon dioxide; how much they impact building energy use and the consequent effects on carbon dioxide emissions from power plants. The calculations are all based on local weather and pollution data which is then converted to a dollar value of the urban forest.

Case Studies in Canada: An application of UFORE on the urban forest in the Town of Oakville, ON can be found at: http://www.oakville.ca/Media_Files/forestry/UFORE.pdf London, ON also conducted a UFORE analysis in 2008/09. The report will be available Fall of 2009 on www.london.ca. The City of Kelowna, B.C. has performed a UFORE and STRATUM analysis.

2.2 STRATUM (Street Tree Resource Analysis Tool for Urban Forest Managers): is a software program developed by researchers at the Center for Urban Forest Research -- a research unit of the USDA Forest Service's Pacific Southwest Research Station and the University of California at Davis to account for the value of street trees. STRATUM uses tree inventory data to quantify the structure, function, value and management needs of any street tree resource. It calculates annual benefits to air quality, energy, CO₂ (Sequestered, Avoided, Decomposition, Maintenance), storm water management and property value increase based on aesthetics, social, psychological, noise abatement and impact on retail sales.

In applications of STRATUM, factoring in the costs associated with planting and upkeep, New York City's street trees provide an annual benefit of about \$122 million, according to the Parks Department. The study concludes that New York receives \$5.60 in benefits for every dollar spent on trees. A study in Davis found that street trees return \$5 for every \$1 spent on their management (internal and external/field).

Case studies in Canada: City of Kelowna, B.C. has performed a UFORE and STRATUM analysis. The City of North Vancouver, BC has conducted a STRATUM analysis.

3.0 The Value of Trees – A Sheet of Useful Statistics

Dollar figures and numbers are often effective in reinforcing the case for tree preservation. Below are summary points from many studies that have tried to quantify the value of trees. References noted are at the end of Section 3. They were compiled by the USDA Forest Service NA-IN-02-04 as part of their *Urban and Community Forestry Appreciation Toolkit*

Economic Contributions

- Research shows that shoppers in well-landscaped business districts are willing to pay more for parking and up to 12% more for goods and services.(27)
- Landscaping, especially with trees, can significantly increase property values. Here is one example: A value of 9% (\$15,000) was determined in a U.S. Tax Court case for the loss of a large black oak on a property valued at \$164,500.(12)

- Trees reduce runoff and erosion from storms by about 7% and reduce the need for erosion control structures. In urban areas with trees, the use of smaller drainpipes can save cities on materials, installation and maintenance.(11)
- Desk workers with and without views of nature were surveyed. Those without views of nature, when asked about 11 different ailments, claimed 23% more incidence of illness in the prior 6 months.(6)
- Amenity and comfort ratings were about 80% higher for a tree-lined sidewalk compared with those for a non-shaded street. Quality of products ratings were 30% higher in districts having trees over those with barren sidewalks.(28)
- In the United States over 200 million cubic yards of urban tree and landscape residue are generated every year.(26) Of the 200 million cubic yards of urban tree and landscape residue, 15% is classified as "unchipped logs." If these logs were sawn into boards, they theoretically would produce 3.8 billion board feet of lumber, or nearly 30% of the hardwood lumber produced annually in the United States.(1)

Energy Savings

- The net cooling effect of a young, healthy tree is equivalent to 10 room-size air conditioners operating 20 hours a day.(20)
- Trees properly placed around buildings as windbreaks can save up to 25% on winter heating costs.(5)
- As few as three trees properly positioned can save the average household between \$100 and \$250 annually in energy costs.(23)
- Fifty million shade trees planted in strategic, energy-saving locations could eliminate the need for seven 100-megawatt power plants.(10)
- Shade from two large trees on the west side of a house and one on the east side can save up to 30% of a typical residence's annual air conditioning costs.(17)
- Annual benefits provided by parking lot trees in Sacramento, California, (8.1% tree shade) were valued at approximately \$700,000 for improved air quality. By increasing shade to 50% in all parking lots in Sacramento, the annual benefits will increase to \$4 million.(9)
- Rows of trees reduce wind-speed by up to about 85%, with maximum reductions increasing in proportion to visual density. Because even a single row of dense conifers can cause large reductions in wind-speed, effective windbreaks can be planted on relatively small house lots. Compared with an open area, a good windbreak that does not shade the house will save about 15% of the heat energy used in a typical home.(4)

Environmental Contributions

- Modest increases of 10% canopy cover in the New York City Area were shown to reduce peak ozone levels by up to 4 parts per billion or by nearly 3% of the maximum and 37% of the amount by which the area exceeded its air quality standard. Similar results were found in Los Angeles and along the East Coast from Baltimore to Boston.(8)
- Leafy tree canopies catch precipitation before it reaches the ground, allowing some of it to gently drip and the rest to evaporate. This lessens the force of storms and reduces runoff and erosion. Research indicates that 100 mature tree crowns intercept about 100,000 gallons of rainfall per year, reducing runoff and providing cleaner water. (25)
- Trees reduce noise pollution by absorbing sounds. A belt of trees 98 feet wide and 49 feet tall can reduce highway noise by 6 to 10 decibels.(13)
- Trees in Davis, California, parking lots reduced asphalt temperatures by as much as 36 degrees Fahrenheit, and car interior temperatures by over 47 degrees Fahrenheit.(16)
- Philadelphia's 2.1 million trees currently store approximately 481,000 metric tons of carbon with an estimated value of \$9.8 million.(14)
- A typical community forest of 10,000 trees will retain approximately 10 million gallons of rainwater per year.(24)

Social Contributions

- Views of nature reduce the stress response of both body and mind when stressors of urban conditions are present.(15)
- Trees in urban parks and recreation areas are estimated to improve outdoor leisure and recreation experiences in the United States by \$2 billion per year.(3)
- Trees reduce crime. Apartment buildings with high levels of greenery had 52% fewer crimes than those without any trees. Buildings with medium amounts of greenery had 42% fewer crimes.(7)
- Hospital patients recovering from surgery who had a view of a grove of trees through their windows required fewer pain relievers, experienced fewer complications, and left the hospital sooner than similar patients who had a view of a brick wall.(21, 22)
- Americans travel about 2.3 billion miles per day on urban freeways and highways. Studies show drivers exposed to roadside nature scenes had a greater ability to cope with driving stresses.(29)
- Symptoms of Attention Deficit Hyperactivity Disorder (ADHD) in children are relieved after contact with nature. Specifically, ADHD kids are better able to concentrate, complete tasks, and follow directions after playing in natural settings. The greener the setting, the more relief.(18)
- Trees help girls succeed. On average, the greener a girl's view from home, the better she concentrates and the better her self-discipline, enabling her to make more thoughtful choices and do better in school.(19)
- Trees and forests in urban areas convey serenity and beauty along a number of sensory dimensions, often surrounding the individual with nature in an environment where natural things are at a premium.(2)



Photo: Barb Heidenreich

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