Appendix A

Benefits of Trees In Urban Areas

Mapleton Avenue, a well shaded street in Boulder, Colorado.

Trees are major capital assets in cities across the United States. Just as streets, sidewalks, public buildings and recreational facilities are a part of a community's infrastructure, so are publicly owned trees. Trees -- and, collectively, the urban forest -- are important assets that require care and maintenance the same as other public property. Trees are on the job 24 hours every day working for all of us to improve our environment and quality of life.

Colorado's urban forest provides many environmental benefits to our community. Aside from the obvious aesthetic benefits, trees within our urban forest improve our air, protect our water, save energy, and improve economic sustainability.

Unlike urban areas in the eastern U.S., canopy cover in Colorado decreases along an urban to rural gradient. In other words, since most trees have been planted much of the tree cover is in urban areas as opposed to "natural lands". Therefore, estimated pollutant uptake rates are higher for residential compared to natural or unmanaged lands. Possible management implications of these estimates are that air pollutant uptake benefits from tree planting may be optimized by planting in areas where air pollutant concentrations are elevated and where relatively high planting densities can be achieved thereby enhancing the health of urban dwellers.

Thank you to Kathleen Alexander for composing and compiling this information.

Urban Forests Improve Our Air Through:

- Carbon Sequestration
- Reduction of Other Pollutants
- More Info on Air Quality Enhancement

Urban Forests Protect Our Water

- Info on Rainfall Interception Provided by Greg McPherson

Urban Forests Save Energy

Urban Forests Can Also:

- Extend the Life of Paved Surfaces
- Increase Traffic Safety
- Improve Economic Sustainability
- Affect Consumer Perceptions and Behaviors
- Add Aesthetic Value
- Increase Real Estate Values
- Increase Sociological Benefits

Other Articles:

- Putting a Value On The Urban Forest of the Front Range (for Colorado Green Magazine)
- What A Large Tree Can Do For You

Urban Forests Improve Our Air

Source: http://www.coloradotrees.org/

Appendix A

Carbon Sequestration:

- Heat from Earth is trapped in the atmosphere due to high levels of carbon dioxide (CO_2) and other heat-trapping gases that prohibit it from releasing heat into space -- creating a phenomenon known as the "greenhouse effect." Trees remove (sequester) CO_2 from the atmosphere during photosynthesis to form carbohydrates that are used in plant structure/function and return oxygen back to the atmosphere as a byproduct. About half of the greenhouse effect is caused by CO_2. Trees therefore act as a carbon sink by removing the carbon and storing it as cellulose in their trunk, branches, leaves and roots while releasing oxygen back into the air.

- Trees also reduce the greenhouse effect by shading our homes and office buildings. This reduces air conditioning needs up to 30%, thereby reducing the amount of fossil fuels burned to produce electricity. This combination of CO_2 removal from the atmosphere, carbon storage in wood, and the cooling effect makes trees a very efficient tool in fighting the greenhouse effect. (11)

- One tree that shades your home in the city will also save fossil fuel, cutting CO_2 buildup as much as 15 forest trees. (16)

- Approximately 800 million tons of carbon are stored in U.S. urban forests with a $22 billion equivalent in control costs. (1)

- Planting trees remains one of the cheapest, most effective means of drawing excess CO_2 from the atmosphere. (15)

- A single mature tree can absorb carbon dioxide at a rate of 48 lbs./year and release enough oxygen back into the atmosphere to support 2 human beings. (10)

- Each person in the U.S. generates approximately 2.3 tons of CO_2 each year. A healthy tree stores about 13 pounds of carbon annually -- or 2.6 tons per acre each year. An acre of trees absorbs enough CO_2 over one year to equal the amount produced by driving a car 26,000 miles. An estimate of carbon emitted per vehicle mile is between 0.88 lb. CO_2/mi. – 1.06 lb. CO_2/mi. (Nowak, 1993). Thus, a car driven 26,000 miles will emit between 22,880 lbs CO_2 and 27,647 lbs. CO_2. Thus, one acre of tree cover in Brooklyn can compensate for automobile fuel use equivalent to driving a car between 7,200 and 8,700 miles. (8)

- If every American family planted just one tree, the amount of CO_2 in the atmosphere would be reduced by one billion lbs annually. This is almost 5% of the amount that human activity pumps into the atmosphere each year. (17)

- The U.S. Forest Service estimates that all the forests in the United States combined sequestered a net of approximately 309 million tons of carbon per year from 1952 to 1992, offsetting approximately 25% of U.S. human-caused emissions of carbon during that period.

- Over a 50-year lifetime, a tree generates $31,250 worth of oxygen, provides $62,000 worth of air pollution control, recycles $37,500 worth of water, and controls $31,250 worth of soil erosion. (2)

Source: http://www.coloradotrees.org/

Appendix A

Reduction of Other Air Pollutants:

- Trees also remove other gaseous pollutants by absorbing them with normal air components through the stomates in the leaf surface. (3).

  Some of the other major air pollutants and their primary sources are:

  - Sulfur Dioxide (SO_2)- Coal burning for electricity/home heating is responsible for about 60 percent of the sulfur dioxide in the air. Refining and combustion of petroleum products produce 21% of the SO_2.

  - Ozone (O_3) - is a naturally occurring oxidant, existing in the upper atmosphere. O_3 may be brought to earth by turbulence during severe storms, and small amounts are formed by lighting. Most O_3 - and another oxidant, peroxyacetylnitrate (PAN) - come from the emissions of automobiles and industries, which mix in the air and undergo photochemical reactions in sunlight. High concentrations of O_3 and PAN often build up where there are many automobiles.

  - Nitrogen oxides - Automotive exhaust is probably the largest producer of NO_x. Oxides of nitrogen are also formed by combustion at high temperatures in the presence of two natural components of the air; nitrogen and oxygen.

  - Particulates are small (<10 microns) particles emitted in smoke from burning fuel, particular diesel, that enters our lungs and cause respiratory problems. (10)

- There is up to a 60% reduction in street level particulates with trees. (1)

- In one urban park (212 ha.) tree cover was found to remove daily 48lbs. particulates, 9 lbs nitrogen dioxide, 6 lbs sulfur dioxide, and 2 lb carbon monoxide ($136/day value based upon pollution control technology) and 100 lbs of carbon. (1)

- One sugar maple (12" DBH) along a roadway removes in one growing season 60mg cadmium, 140 mg chromium, 820 mg nickel, and 5200 mg lead from the environment. (1)

  - Planting trees and expanding parklands improves the air quality of Los Angeles county. A total of 300 trees can counter balance the amount of pollution one person produces in a lifetime. (10)

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Source: http://www.coloradotrees.org/

Appendix A

Urban Forests Protect Our Water

- Trees reduce topsoil erosion, prevent harmful land pollutants contained in the soil from getting into our waterways, slow down water run-off, and ensure that our groundwater supplies are continually being replenished. For every 5% of tree cover added to a community, stormwater runoff is reduced by approximately 2%. (1)

- Research by the USFS shows that in a 1 inch rainstorm over 12 hours, the interception of rain by the canopy of the urban forest in Salt Lake City reduces surface runoff by about 11.3 million gallons, or 17%. These values would increase as the canopy increases. (13)

- Along with breaking the fall of rainwater, tree roots remove nutrients harmful to water ecology and quality. (13)

- Trees act as natural pollution filters. Their canopies, trunks, roots, and associated soil and other natural elements of the landscape filter polluted particulate matter out of the flow toward the storm sewers. Reducing the flow of stormwater reduces the amount of pollution that is washed into a drainage area. Trees use nutrients like nitrogen, phosphorus, and potassium--byproducts of urban living--which can pollute streams.

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Source: http://www.coloradotrees.org/

Appendix A

Urban Forests Save Energy

· Homeowners that properly place trees in their landscape can realize savings up to 58% on daytime air conditioning and as high as 65% for mobile homes. If applied nationwide to buildings not now benefiting from trees, the shade could reduce our nation's consumption of oil by 500,000 barrels of oil/day. (12)

· The maximum potential annual savings from energy conserving landscapes around a typical residence ranged from 13% in Madison up to 38% in Miami. Projections suggest that 100 million additional mature trees in US cities (3 trees for every unshaded single family home) could save over $2 billion in energy costs per year. (10)

· Trees lower local air temperatures by transpiring water and shading surfaces. Because they lower air temperatures, shade buildings in the summer, and block winter winds, they can reduce building energy use and cooling costs. (6)

· Help to cool cities by reducing heat sinks. Heat sinks are 6-19 degrees F^{o} warmer than their surroundings (Global Releaf GA). A tree can be a natural air conditioner. The evaporation from a single large tree can produce the cooling effect of 10 room size air conditioners operating 24 hours/day. (18)

- USFS estimates the annual effect of well-positioned trees on energy use in conventional houses at savings between 20-25% when compared to a house in a wide-open area. (USFS meteorologist Gordon Heisler)(13).

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Urban Forests Can Extend the Life of Paved Surfaces

Source: http://www.coloradotrees.org/

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The asphalt paving on streets contain stone aggregate in an oil binder. Without tree shade, the oil heats up and volatizes, leaving the aggregate unprotected. Vehicles then loosen the aggregate and much like sandpaper, the loose aggregate grinds down the pavement. Streets should be overlaid or slurry sealed every 7-10 years over a 30-40 year period, after which reconstruction is required. A slurry seal costs approximately $0.27/sq.ft. or $50,000/linear mile. Because the oil does not dry out as fast on a shaded street as it does on a street with no shade trees, this street maintenance can be deferred. The slurry seal can be deferred from every 10 years to every 20-25 years for older streets with extensive tree canopy cover. (19)

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Urban Forests Can Increase Traffic Safety

- Trees can also enhance traffic calming measures, such as narrower streets, extended curbs, roundabouts, etc. Tall trees give the perception of making a street feel narrower, slowing people down. Closely spaced trees give the perception of speed (they go by very quickly) slowing people down. A treeless street enhances the perception of a street being wide and free of hazard, thereby increasing speeds. Increased speed leads to more accidents. (20)
- Trees can serve as a buffer between moving vehicles and pedestrians.
- Street trees also forewarn drivers of upcoming curves. If the driver sees tree trunks curving ahead before seeing the road curve, they will slow down and be more cautious when approaching curves. (16)

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Urban Forests Can Improve Economic Sustainability

- The scope and condition of a community's trees and, collectively, its urban forest, is usually the first impression a community projects to its visitors. A community's urban

Source: http://www.coloradotrees.org/

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forest is an extension of its pride and community spirit.

Studies have shown that:

1. Trees enhance community economic stability by attracting businesses and tourists.
2. People linger and shop longer along tree-lined streets.
3. Apartments and offices in wooded areas rent more quickly and have higher occupancy rates.
4. Businesses leasing office spaces in developments with trees find their workers are more productive and absenteeism is reduced. (11)

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Urban Forests Can Increase Real Estate Values

- Property values increase 5-15% when compared to properties without trees (depends on species, maturity, quantity and location)
- A 1976 study that evaluated the effects of several different variables on homes in Manchester, Connecticut, found that street trees added about $2686 or 6% to the sale price of a home. (10)
- A more recent study indicated that trees added $9,500, or more than 18 percent, to the average sale price of a residence in a suburb of Rochester, New York. (8)

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Urban Forests Can Increase Sociological Benefits

- Two University of Illinois researchers (Kuo and Sullivan) studied how well residents of the Chicago Robert Taylor Housing Project (the largest public housing development in the world) were doing in their daily lives based upon the amount of contact they had with trees, and came to the following conclusions:
  - Trees have the potential to reduce social service budgets, decrease police calls for domestic violence, strengthen urban communities, and decrease the incidence of child abuse according to the study. **Chicago officials heard that message last year. The city government spent $10 million to plant 20,000 trees, a decision influenced by Kuo's and Sullivan's research, according to the *Chicago Tribune*.**

Source: http://www.coloradotrees.org/

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- Residents who live near trees have significantly better relations with and stronger ties to their neighbors.
- Researchers found fewer reports of physical violence in homes that had trees outside the buildings. Of the residents interviewed, 14% of residents living in barren conditions have threatened to use a knife or gun against their children versus 3% for the residents living in green conditions. (15)

- Studies have shown that hospital patients with a view of trees out their windows recover much faster and with fewer complications than similar patients without such views. (13)
- A Texas A&M study indicates that trees help create relaxation and well being.
- A U.S. Department of Energy study reports that trees reduce noise pollution by acting as a buffer and absorbing 50% of urban noise.

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What a Large Tree Can Do For You

- A large front yard tree in a San Joaquin Valley community like Modesto (dry like Colorado) provides the following benefits each year:
- 1. Saves $30 in summertime air conditioning by shading the building and cooling the air (250 kWh), about 9% of total annual air conditioning cost.
- 2. Absorbs 10 lbs of air pollutants, including 4 lbs of ozone and 3 lbs of particulates. The value of pollutant uptake by the tree is $45 using the local market price of emission reduction credits. Uptake of NOx by the tree is equivalent to NOx emitted by a typical car driven 3,600 miles.
- 3. Intercepts 760 gal of rainfall in its crown, thereby reducing runoff of polluted stormwater and flooding. This benefit is valued at $6 based on local expenditures for water quality management and flood control.
- 4. Cleans 330 lbs of CO2 (90 lbs C) from the atmosphere through direct sequestration in the tree's wood and reduced power plant emissions due to cooling energy savings. The value of this benefit is $5 assuming the California Energy Commission's price of $30/ton. This tree reduces the

Source: http://www.coloradotrees.org/

same amount of atmospheric CO2 as released by a typical car driven 500 miles.

5. Adds about 1% to the sales price of the property, or about $25 each year when annualized over a 40-year period. This assumes a median residential property sales price of $100,000.

The value of all benefits is $111 in this example. Typically, a city will spend $20-$40 per year to maintain a street tree of this size (sometimes located in a front yard easement) and a resident will spend about $10 per year maintaining a large yard tree. Our benefit-cost analysis for Modesto's 90,000 street/park trees found $1.89 returned annually for every $1 invested in stewardship.

--Greg McPherson

(top)

Air Quality and Trees

We all know that trees give us shade, protect us from wind and rain, add beauty to a home landscape, soften the harsh lines of urban architecture, provide homes for birds and squirrels, and much, much more. Most of us can't imagine a city without trees. They have become part of the infra structure like the streets, lights, sidewalks, schools, and other city assets. Quantifying the value of these benefits is difficult but there are researchers doing just that. Here is some recent information from David Nowak, a researcher with the USDA Forest Service in Syracuse, NY. He is answering some questions asked by city forester.

I've heard that 1 ac of trees provides oxygen for 18 people every day a) how many trees per ac are we talking and what type & size of trees? b) how much oxygen does a person need every day?

Based on field data and modeling for Brooklyn, NY (Nowak et al, in review), one acre of tree cover in Brooklyn gives off an approximate net amount of 2.8 t O2/yr (this estimate does not include tree decomposition). Estimated annual average net oxygen production for Brooklyn trees is (for various dbh classes):

DBH Class (in)	Oxygen produced (lbs/yr)
0-3	6
9-12	49
18-21	115
27-30	148
39+	247

a) The average density in a forest stand is around 480 tree/ac (e.g., Raile and Leatherberry, 1988). Average tree density within tree covered urban areas is approximately 204 trees/ ac of tree cover. This estimate is based on field data from 7 cities (Dwyer et al., in review). In the Chicago area (Cook and DuPage Counties), 77% of the trees were less

Source: http://www.coloradotrees.org/

than 6 in. dbh. (Nowak, 1994a).

b) The average annual oxygen consumption for a person at rest at 20 degrees C and 760 mm Hg (standard pressure) is between 355 lbs/yr and 444 lbs/yr (average = 400 lbs O2/ yr). This is a conservative estimate as exercise will increase oxygen consumption.

Based on the above estimates of oxygen consumption and net oxygen production by an acre of tree cover in Brooklyn, one acre of trees would produce enough oxygen for 14 people. However, it is debatable as to whether oxygen production by an acre of trees or large tracts of forests are significant, because if the acre of trees did not exist, 14 people would not suffocate from lack of oxygen. There are many sources of oxygen and plenty of oxygen in the atmosphere, but trees do contribute oxygen to the atmosphere. "We have a large number of serious ecological problems, but suffocation from lack of oxygen is not one of them (Broeker 1970, SCEP 1970). The oxygen content of the atmosphere remains essentially constant, with the oxygen consumed by all animals, bacteria, and respiration processes roughly balanced by the oxygen released by land and sea plants during photosynthesis. The present atmospheric oxygen content seems not to have changed since 1910 (SCEP 1970). Furthermore, because air is about 20 percent oxygen, the total supply is immense (Broeker 1970)" (Miller,1979). Waters of the world are the main oxygen generators of the biosphere; their algae are estimated to replace about 90% of all oxygen used (Encyclopedia Brittannica, 1994). Also, most of the oxygen produced by trees will be consumed when the tree dies and decomposes.

I've read that 1 ac of trees absorbs enough CO_2 in a year is equal to that produced from driving a car 26K miles. a) how much CO_2 does 1 ac of trees absorb in 1 year? b) how much CO_2 does driving a car 26K mi produce?

a) this answer depends on tree density per acre, diameter structure, species composition, and growth rates. Estimates from Chicago are 2.7 t C/ac of tree cover/yr (Nowak 1994b); the Chicago area: 2.2 t C/ac of tree cover/yr (Nowak, 1994b); and in Brooklyn, NY: 1.0 t C/ac of tree cover/yr (Nowak et al., in review). These are gross carbon sequestration estimates and do not account for carbon emitted due to decomposition. The Chicago estimates are likely liberal as they do not account for tree condition or stand structure effects on growth. Gross carbon sequestration estimates for individual trees in Brooklyn, by various diameter classes are (Nowak et al., in review):

DBH Class (in)	**Carbon Sequestration (lbs/yr)**
0-3	2
9-12	19
18-21	43
27-30	55
39+	93

b) Estimate of carbon emitted per vehicle mile is approximately 0.24 lb C/mi (see Nowak, 1993 for calculation and references) but is as high as 0.29 lb C/mi if carbon produced from transportation and fuel processing is included. Thus, a car driven 26,000 miles will emit 6,240 lbs C (22,880 lbs CO_2) or 7,540 lbs C (27,647 lbs CO_2) if the whole fuel process is included. Thus, one acre of tree cover in Brooklyn can compensate for automobile fuel use equivalent to driving a car between 7,200 and 8,700 miles, depending on which estimate you choose to use. However, when the tree dies, most, if not all, of the carbon stored will eventually be released back to the atmosphere and form CO_2. Thus, the CO_2 gains made by trees are sustained as long as the forest structure is sustained. Also, the gains made are

Source: http://www.coloradotrees.org/

only good for the first generation of trees, unless the carbon is prevented from decomposing. If first generation decomposes, the second generation of trees will only compensate for the loss of the first generation (Nowak et al., in preparation).

What about the statement, 1 ac of trees store 2.6 tons of carbon each year (removed from the air) where does the carbon in the air come from?

See answer 2a for urban forest estimates.

Carbon in the atmosphere comes mainly from fossil fuel combustion (emissions of approximately 5 billion metric tons/yr) and deforestation (loss of stored carbon in biomass) (emissions of about 1-2 billion metric tons/yr) (Schneider, 1989). Carbon in trees comes from atmospheric carbon dioxide (a very minor portion may come from other chemicals containing carbon [e.g., carbon monoxide], but many of these chemicals convert to carbon dioxide through time).

Trees remove several tons/day of O_3, CO_2, SO_2, NO_2, PM_{10}. How many trees does it take to remove so many tons of one element?

We are currently completing a comparison of pollution removal by trees in 50 cities across the United States. Pollution removal varies based on meteorology, amount of tree and shrub cover (acres), pollution concentration, and length of growing season. Pollution removal (ozone, particulate matter, sulfur dioxide, nitrogen dioxide, and carbon monoxide) by trees and shrubs in Chicago in 1994 was estimated at 651 tons (rates varied for each pollutant) (Nowak, 1994c). In Brooklyn,1994 pollution removal (same 5 pollutants) by trees and shrubs was estimated at 287 tons (Nowak et al., in review). Average individual tree pollution removal estimates for Brooklyn by various diameter classes are:

DBH Class (in)	**Pollution Removal (lbs/yr)**
0-3	0.07
9-12	0.8
18-21	2.2
27-30	2.0
39+	5.3

Differences in removal rates per tree by diameter classes are due to differences in the average amount of healthy leaf area per tree among the diameter classes.

Where did the info come from on trees reducing urban temps & the 2% increase in electricity consumption for every 1 deg.?

"For U.S. cities with populations larger than 100,000, peak utility loads will increase 1.5 to 2 percent for every 1 degree F increase in temperature" is from page 16 of Akbari et al. (1992). On page 18 it reports "the nation-wide response of peak-cooling electricity load to temperature in the United States could range from 0.5 to 3 percent for each 1 degree F rise in temperature." It appears that these figures may come from Linder and Inglis (1989). It is important to note that these data are for peak loads. However, from a graph on page 20, it appears that annual energy use could increase between 0.25% and 3% (average of approx. 1.1%) per degree F rise in temperature, depending on city location.

Source: http://www.coloradotrees.org/

Appendix A

How much carbon does a tree store in its wood? Is it based on size ?

One half of a tree's dry weight is carbon (see Nowak, 1994b for various citations). Thus carbon storage is directly related to size (i.e., bigger trees have more carbon stored). Annual carbon sequestration (the amount of carbon removed from the atmosphere each year) is related to tree size and growth rates (large trees with fast growth rates will remove more carbon annually than small trees with slow growth rates).

How is the value derived from the in leaf pollution removal (Dave Nowak's research)?

Values are derived based on median environmental externality values for the United States for each pollutant from Murray et al. (1994) (Nowak et al, 1998). Environmental impacts or damage caused by pollutant emissions are one type of environmental externality. Externalities include benefits and costs resulting as an unintended byproduct of economic activity that accrue to someone other than the parties involved in the activity. Externality values attempt to account for

the cost to society due to the pollutant emission, and are usually given in $/ton. There are various limitations with certain approaches to obtaining externality values, but externality values are one of the most reasonable approaches to valuing the functions of urban forests, particularly if the externality value is directly derived from the societal costs of the pollutant emitted into the atmosphere (e.g., human health, materials damage, etc.).

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(top)

Rainfall Interception of Trees

This info was requested by Bailey Hudson and I pass it on in case anyone else is interested. It is an estimate of rainfall interception by a thoroughly saturated tree (0.5 inch storm). Tree data are based on destructive sampling of a callery pear tree in Davis and interception is based on our measurements and modeling studies using this tree. Visit our web site for related publications (http://wcufre.ucdavis.edu). -- Greg.

Tree age: 9 years
Size: 28 ft tall, 19 ft crown diameter, 276 sq ft crown projection area (CPA), 1,923 sq ft leaf area, 446 sq ft stem area
Saturation storage: leaf = 0.04 inch, stem = 0.04 inch
Rainfall: 0.5 inches
Interception by leaf: 47.2 gal
Interception by stem: 10.9 gal
Total interception: 58.1 gal
Total precip in CPA: 86.1 gal
Interception %: 68%

These values assume no evaporation from the crown so actual interception will increase as temperatures and wind speed increase and thereby drive higher evap rates. Inotherwords, this is a lowball estimate for an in-leaf pear. We are beginning to measure the saturation storage capacity for different tree species

Source: http://www.coloradotrees.org/

and this info will improve our ability to accurately model impacts of urban forests on stormwater runoff.

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(top)

Trees and Commercial Business

Trees and business - It's often a love-hate relationship! There are certainly costs that come with having trees on streets. Yet, a new study provides evidence that trees have positive effects on consumers. Despite their costs, trees do provide indirect benefits to businesses.

About 70% of America's gross domestic product is generated by the purchases of individuals. Consumers consider many factors when deciding on what products and services to buy. Value, quality and convenience are major messages that marketers communicate about their products. Often overlooked is the importance of the retail place on shopping decisions. A pleasant, welcoming retail environment is important to consumers.

How does the community forest influence consumers? A national study, conducted by social scientists at the University of Washington, used survey questionnaires to investigate public perceptions about the role of trees in revitalizing business districts. Surveys were sent to selected districts in cities of the Pacific Northwest, Austin, Los Angeles, Chicago, Pittsburgh, and Washington, DC.

CONSUMER PERCEPTIONS AND BEHAVIORS

Place Perception
Four categories of perceptions emerged from participant' ratings of three business districts: *Amenity and Comfort, Interaction with Merchants, Quality of Products, Maintenance and Upkeep.*

Consumers' ratings on each of the categories was significantly higher for districts that had street trees and other landscape improvements. For instance, *Amenity and Comfort ratings* were about 80% higher for a tree lined sidewalk compared to a non-shaded street. Also, *Quality of Products,* ratings were 30% higher in districts having trees over those with barren sidewalks. Interaction with Merchants items included customer service issues; ratings were about 15% higher

Source: http://www.coloradotrees.org/

Appendix A

for districts with trees.

Patronage Behavior
Actions follow our impressions of a place. Respondents were asked to give opinions of their behavior within the three shopping districts, including travel time, travel distance, duration of a visit, frequency of visits and willingness-to-pay for parking. Again, trees make a difference! Considering ALL behaviors, higher measures were reported in the districts having trees. For instance, respondents claimed they would be willing to pay more for parking in a well landscaped business district. This suggests greater revenues from shaded parking could offset the costs of parking space loss, a frequent objection by merchants.

Pricing Patterns
Do trees influence how much people are willing to pay for goods? Contingent valuation methods were used to assess how amenity values relate to customers' price valuations. Survey respondents were asked to specify a price for each of 15 items in a "basket of goods" in the business districts. The survey participants consistently priced goods significantly higher in landscaped districts! Prices were, on average, about 11% higher for products in the landscape compared to the no-tree district. This was true of low-price, impulse-buy convenience goods (e.g. lunch sandwich, flower bouquet), as well as bigger ticket, comparison-shopped items (e.g. sports shoes, new glasses). Give the low profit margins of most retail businesses, trees appear to provide a significant "amenity margin."

(top)

Source: http://www.coloradotrees.org/