Be Green – Be Well: city trees & greening for health & wellness

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University of Washington
College of the Environment

Think Trees NM
Urban Tree Care Conference
January 2014

nearby nature is a necessity
for every person on your community
Volunteer Characteristics
Volunteer History
Motivations
Skills and Contributions
Satisfactions
Personal Health & Well-Being
155 people surveyed
Willing to Contribute?
dependent variables – rating 1-5

- Vegetation Management mean 4.35 s.d. 0.81
  - Invasive plant removal
  - Plant maintenance
  - Planting native plants
- Light Construction mean 3.66 s.d. 1.23
  - Construction of simple structures
  - Trail building and maintenance
- Technical Knowledge mean 2.98 s.d. 1.13
  - Providing IT support, such as mapping or social media
  - Natural history and ecological knowledge in the field
- Policy & Administration mean 2.94 s.d. 1.09
  - Outreach to decision-makers and key community leaders
  - Strategic planning and visioning
  - Help with fund-raising
  - Project or event planning

Satisfactions of volunteering?
dependent variables – rating 1-7

- Making a Difference mean 5.51 s.d. 1.26
  - The difference my volunteer work is making
  - The chance I have to utilize my knowledge and skills in my volunteer work
  - The progress that I have seen in the lands served by the organization(s)
- Organizational Support mean 5.36 s.d. 1.22
  - The support I receive from people in the organization(s)
  - The availability of getting help when I need it when volunteering
  - How often volunteer work is acknowledged
- Social Interactions mean 5.34 s.d. 1.27
  - The amount of interaction I have with other volunteers in the organization
  - The amount of time spent with other volunteers
  - The friendships I have made while volunteering
Why is volunteering important to you?

dependent variables – rating 1-7

Engaged Learning  mean 5.39  1.10sd
I am genuinely concerned about the environmental purpose that I am volunteering for,
I can learn more about the cause for which I am working

Caring for Others  mean 4.82  1.65sd
I feel compassion toward people in need (16)
I feel it is important to help others (19)

Group Dynamics  mean 4.11  1.68sd
The morale of my group improves after we volunteer as a team
Our group works together better as a team because of volunteering

Self Reflection  mean 3.77  1.49sd
Volunteering increases my self-esteem
Volunteering makes me feel important

Social Influence  mean 3.76  1.5sd
Volunteering is an important activity to the people I know best
People I know share an interest in community service for the environment

Career Opportunity  mean 3.18  1.64sd
Volunteering can help me get my foot in the door at a place where I’d like to work
I can make new contacts that might help my business career

Solace  mean 3.11  1.62sd
Volunteering allows me to escape from my own troubles
No matter how bad I’ve been feeling, volunteering helps me to forget about it

Cascade Land Conservancy – USFS Pacific NW Research Station

in the background

nearby nature for human health & well-being
City Trees & Urban Greening = Health Benefits

intuition to evidence
‘cradle to grave’

research evidence
a sampler

Urban Trees & Greening
Human Health, Welfare & Function
Urban Forests and Newborns
the natural environment may affect
pregnancy outcomes . . .

10% increase in tree-canopy cover
within 50m of a house
= lower number of low weight births
(1.42 per 1000 births)

Donovan et al., Health & Place, 2011

Nature & Psych Development
children’s play & imagination
Nature Deficits
Richard Louv

http://www.treeclimbing.jp/
physically disabled & tree climbing!

recreational tree climbing – youth therapy
Ascending the Giants

Portland, Oregon

Old-growth Ecology Tour

The third aspect of the Old Growth Tree Tour is a vertical exploration in an ancient grove of towering Douglas-fir, Grand Fir and Western Red Cedar. Here, the ATS team will assist your group toward the top of an old growth tree with PhD arboriculturist, Dr. David Anderson. For a captivating view over the nation’s largest and oldest city park, Forest Park, Dr. Anderson will be your personal guide explaining the ecological functionality of this forest and the forest/silva forest interface.

Explore and experience the tree shootway in an actual Oregon old growth forest green in a real and unique manner that is guaranteed to be safe and unforgettable.
School & Learning

- College students with more natural views from their dorm windows
  - scored higher on tests of capacity to direct attention
  - rated themselves as able to function more effectively

Journal of Environmental Psychology
Green High School Campuses

- cafeteria & classroom window views with greater quantities of trees and shrubs
- positively associated with:
  - standardized test scores,
  - graduation rates
  - % of students planning to attend a four-year college
  - fewer occurrences of criminal behavior

Matsuoka. 2010. Landscape & Urban Planning

Parks & People Foundation, Baltimore
first phase - reading circle
nature recovery & schools

planning skills & efficacy
What is the Evidence?

Urban Greening & Nearby Nature
Human Health, Welfare & Function

Research Reviews

on-line resource
summaries complete: soon!

www.greenhealth.washington.edu
Research Review and Summaries

Sponsors:
University of Washington
USDA Forest Service, U&CF Program
NGO partners

thanks to U of WA students:
Katrina Flora
Mary Ann Rozance
Sarah Krueger

Local Economics

Trees in cities are not grown and managed for products that can be bought and sold on markets, but they do provide many intangible services and functions. This article serves two purposes. First, it introduces valuation methods that are used to convert intangible benefits to dollar sums.  

Then, it shows how nonmarket valuations can support local decision-making.

Fast Facts

• The presence of larger trees in yards and as street trees can add from 3% to 15% to home values throughout neighborhoods.
• Averaging the market effect of street trees on all house values across Portland, Oregon yields a total value of $1.35 billion, potentially increasing annual property tax revenues $15.3 million.
• A study found 7% higher rental rates for commercial offices having high quality landscapes.
• Shoppers claim that they will spend 9% to 12% more for goods and services in central business districts having high quality tree canopy.
• Shoppers indicate that they will travel greater distances and a longer time to visit a district having high quality trees, and spend more time there once they arrive.
Datasheet for each theme

- research highlights
- one page briefing
- print & share

Urban Green :: Human Health & Well Being

> 2,600 articles

<table>
<thead>
<tr>
<th>Category</th>
<th>1970s</th>
<th>1980s</th>
<th>1990s</th>
<th>2000s</th>
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<tbody>
<tr>
<td>Safe Streets</td>
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<tr>
<td>Crime &amp; Fear</td>
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<tr>
<td>Work &amp; Learning</td>
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<td>Nature &amp; Land Uses</td>
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<td>Healing &amp; Therapy</td>
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<td>Place Attachment &amp; Meaning</td>
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<td>Culture &amp; Equity</td>
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<td>Wellness &amp; Physiology</td>
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<td>Mental Health &amp; Function</td>
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<td>Community Building</td>
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<td>Reduced Risk</td>
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<td>Livable Cities</td>
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<td>Lifecycle &amp; Gender</td>
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<tr>
<td>Community Economics</td>
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<td>Active Living</td>
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</tbody>
</table>

% distribution

- unknown
- 1970s
- 1980s
- 1990s
- 2000s
Eco-Health Relational Browser
Environmental Protection Agency

www.epa.gov/research/healthscience/browser/
Click a topic bubble or choose a topic from the dropdown list above. Hover over linkages (+) to view relationship between elements.

Urban Ecosystems

Air Filtration

Engagement with Nature

Fire Mitigation

Water Filtration

Water Regulation

Promotion of Physical Activity

Citations of Key Studies
Guidetti, S., Keenan, R. 2000. Urban green spaces and urban forests can exist within a single urban region. The services provided by urban ecosystems include filtering water runoff, providing areas for physical activity and recreation, such as hunting and bird watching, and mitigating the Urban Heat Island effect by replacing heat-absorbing impervious surfaces and increased shading from shade trees.


Almanza E, M Jerrett, et al. 2012. A study of community design, greenness, and physical activity in children using satellites, GPS and accelerometer...
Urban Greening & Health Evidence Framework

Abraham Maslow Hierarchy of Needs

Self-actualization
- morality, creativity, spontaneity, problem solving, lack of prejudice, acceptance of facts

Esteem
- self-esteem, confidence, achievement, respect of others, respect by others

Love/belonging
- friendship, family, sexual intimacy

Safety
- security of body, employment, resources, morality, the family, health, property

Physiological
- breathing, food, water, sex, sleep, homeostasis, excretion
More Benefits!
based on scientific evidence

Attention Restoration Theory
Rachel & Stephen Kaplan U of MI
**Workplace Nature Views**

- **Well-being**
  - desk workers without view of nature reported 23% more ailments in prior 6 months

- **Job Satisfaction**
  - less frustrated and more patient
  - higher overall job satisfaction and enthusiasm

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**ART Design Elements**

- being away
- ‘soft’ fascination
- extent
- compatibility

Urban Nearby Nature Aging & Health

Nature, Human Health & Walkable Neighborhoods

- Environments: Neighborhood Streets (Tokyo)
  - tree-lined
  - parks

- Outcomes: Elderly People & Walking
  - less illness
  - lower mortality rate over 5 years

Physical Activity & Depression Reduction

- Review of 13 high quality studies
  - exercise recommended for mild to moderate depression
  - people who are willing & motivated
  - associated meditation and mindfulness are important

**Shinrin-yoku  Forest Bathing**

- extended forest walks
  - reduced ‘fight or flight’ nervous system activity
  - lower cortisol – a stress indicator
  - increased immune function
  - lower pulse rate & blood pressure

**Elders & Horticulture Therapy**
方法
実験1:
課題①:2種の土を混ぜる
課題②:土を鉢に入れる
課題③:花を鉢に植える

Dr. Masahira Toyoda;
University of Hyogo, Kobe

フォルダ装着位置は、額の正中位で且つ眉から1cm上とした

図: 各課題の手順（数字は秒）

図

園芸作業中のOxy-Hb濃度変化
hospital healing gardens:
patients; family and friends; professional staff

health care $$
savings

healing gardens
soothing
distracting
calm focus
xeriscape for healing & therapy

Effects of nature window view on recovery from surgery (Roger Ulrich, 1984)

- Shorter stays
- Less pain
- Fewer minor complications
- Better emotional well-being
PAIN CONTROL DURING BRONCHOSCOPY

80 patients undergoing bronchoscopy

40 viewed a pristine meadow scene, heard bubbling brook sounds

29.3% with “very good” or “excellent” pain control

40 controls

20.5% with “very good” or “excellent” pain control

new efforts & messages

TKF Foundation Annapolis MD

public green spaces that please the eye, nourish the soul, and help renew communities
Design Elements

Portal :: Path :: Destination :: Surround

portal :: path :: surround :: destination
Open Spaces Sacred Spaces

grants program – integrated design & research
Portland OR Legacy Hospitals
Stewardship Organization Mission
King/Pierce Counties ~ 600

Wordle tag cloud
Ergonomics?

- human factors
- physics, mechanics & human anatomy
- designing things so that a person can use them easily & safely
- original design & retrofit
- improving productivity
- evidence-based

basic things in life . . . .

happy or miserable?
gardening tools!

**GOOD**
- hand and wrist in neutral, stress-free position
- soft grip ergonomic handle

**POOR**
- stressful less force
- stretched tendons on upper wrist; compressed tissues on lower wrist; callouses on palm

desk jobs
motorcycle ‘posture’

ERGOS

- BMW K1200GT
- Kawasaki Concours 14
- Yamaha FJR1300A

car interior design
ok . . . . enough

“Your attention to ergonomics is getting out of hand.”

Ergonomics promotes greater productivity...
...not just comfort!

environmental functions
urban forest benefits

Improving Air Quality

Image courtesy of the Center for Urban Forest Research
Reducing Stormwater Runoff

Sustainable Sites Initiative :: SITES Case Studies
landscape function comparison

In the native garden (above), California native cultivars replicate the drought-tolerant chapparal of the Santa Monica Mountains and use 77 percent less water than required by conventional turf and exotic plants from the Eastern United States and Europe in the traditional garden (right).
### The Numbers Speak for Themselves

**Traditional Landscape**

<table>
<thead>
<tr>
<th>Water</th>
<th>Yard Waste</th>
<th>Maintenance Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>17,000 Gallons</td>
<td>350 Pounds</td>
<td>80 Hours</td>
</tr>
</tbody>
</table>

**Sustainable Landscape**

<table>
<thead>
<tr>
<th>Water</th>
<th>Yard Waste</th>
<th>Maintenance Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>6,000 Gallons</td>
<td>150 Pounds</td>
<td>15 Hours</td>
</tr>
</tbody>
</table>

*Comparisons for new use based on published data.*

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**Stormwater Management**

*Pierce County WA, Chambers Creek Properties*
Pierce County WA, Chambers Creek Properties - 4 year growth

stormwater management
Tanner Springs Park
Portland OR

linked to active living network
Urban Heat Island Effect
studies by NASA & EPA

urban trees = mitigation
Home & Neighborhood Trees

Tree Benefit Calculator for street trees

Understanding This Tool:

The Tree Benefit Calculator allows anyone to make a simple estimation of the benefits individual street-side trees provide. This tool is based on research about the environmental and economic value street trees provide. With inputs of location, species and tree size, users get an understanding of the environmental and economic value trees provide on an annual basis.

The Tree Benefit Calculator is intended to be simple and accessible. As such, this tool should be considered a starting point for understanding tree value in the community, rather than a scientific accounting of precise values. For more detailed information on urban and community forest assessments, visit the Tree website.

National Tree Benefit Calculator

Thank you for choosing this site to calculate the economic and ecological benefits of your tree.

Find your climate zone to get started:
Enter your zip code below:

-OR-
Select a zone from the map

The National Tree Benefit Calculator was conceived and developed by Case Trees and Davey Tree Expert Co.
This 30 inch Western red cedar provides overall benefits of: $262 every year.

While some functional benefits of trees are well documented, others are difficult to quantify (e.g., human social and communal health). Trees' specific geography, climate, and interactions with humans and infrastructure is highly variable and makes precise calculations that much more difficult. Given these complexities, the results presented here should be considered initial approximations—a general accounting of the benefits produced by urban street-side plantings.

Benefits of trees do not account for the costs associated with trees' long-term care and maintenance. If this tree is cared for and grows to 35 inches, it will provide $266 in annual benefits.

This 10 inch Ponderosa pine provides overall benefits of: $20 every year.

While some functional benefits of trees are well documented, others are difficult to quantify (e.g., human social and communal health). Trees' specific geography, climate, and interactions with humans and infrastructure is highly variable and makes precise calculations that much more difficult. Given these complexities, the results presented here should be considered initial approximations—a general accounting of the benefits produced by urban street-side plantings.

Benefits of trees do not account for the costs associated with trees' long-term care and maintenance. If this tree is cared for and grows to 15 inches, it will provide $48 in annual benefits.
## Yard & Street Trees

<table>
<thead>
<tr>
<th>Value Increase</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>2%</td>
<td>mature yard trees (greater than 9-inch dbh)</td>
</tr>
<tr>
<td>3%</td>
<td>larger street trees (up to 100’ away)</td>
</tr>
<tr>
<td>3-5%</td>
<td>trees in front yard landscaping</td>
</tr>
<tr>
<td>6-9%</td>
<td>good tree cover in a neighborhood</td>
</tr>
<tr>
<td>10-15%</td>
<td>mature trees in high-income neighborhoods</td>
</tr>
</tbody>
</table>
### Tree Retention In Development

<table>
<thead>
<tr>
<th>Value Increase</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>18%</td>
<td>building lots with substantial mature tree cover</td>
</tr>
<tr>
<td>22%</td>
<td>tree-covered undeveloped acreage</td>
</tr>
<tr>
<td>19-35%</td>
<td>lots bordering suburban wooded preserves</td>
</tr>
<tr>
<td>37%</td>
<td>open land that is two-thirds wooded</td>
</tr>
</tbody>
</table>

### Parks & Open Space

**proximate principle**

<table>
<thead>
<tr>
<th>Value Increase</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>inner city home located within 1/4 mile of a park</td>
</tr>
<tr>
<td>17%</td>
<td>home near cleaned-up vacant lot</td>
</tr>
<tr>
<td>20%</td>
<td>home adjacent to or fronting a passive park area</td>
</tr>
<tr>
<td>32%</td>
<td>residential development adjacent to greenbelts</td>
</tr>
</tbody>
</table>
Local Government Benefits

Civic Investment – Public Goods

*like schools, emergency response, roads*

- street trees average positive effect on house values
- added up across Portland, Oregon
- yields a total value of $1.35 billion
- potentially increasing annual property tax revenues
  $15.3 million

Donovan & Butry. 2010
*Landscape and Urban Planning*

human health & well-being

nearby nature & physical activity
City Trees and Public Health

- risks and toxics in the environment – one side of the story
- another perspective . . . .
  Howard Frumkin
  Centers for Disease Control
  nature as health asset
- community and nature planning for health

Physical Inactivity & Obesity

- majority of Americans not active enough
  goal-30 minutes per day of moderate activity
  to reduce risk factors for chronic diseases
    (heart, stroke, cancer, diabetes)
- significant costs to national health services

- $168 billion medical costs
- 17% of all U.S. medical costs
- + $1,429 per person per year for obese vs not

CDC 2010
Obesity Trends* Among U.S. Adults

1985

(*BMI ≥30, or ~ 30 lbs overweight for 5’ 4” person)

Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

2010

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: Behavioral Risk Factor Surveillance System, CDC.
Age-adjusted % of adults aged ≥20 years who are obese, 2007

Obesity Trends* Among U.S. Adults
BRFSS, 1990, 2000, 2010
(*BMI ≥30, or about 30 lbs. overweight for 5' 4" person)

Source: Behavioral Risk Factor Surveillance System, CDC.
overweight kids . . . obese adults

**Obesity Is Found to Gain Its Hold in Earliest Years**
*NY Times*

Experts say the results of a major new study may reshape approaches to combating the nation's obesity epidemic, suggesting that efforts must start much earlier and focus more on the children at greatest risk.

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**City Trees & Nature**
**Active Living**

<table>
<thead>
<tr>
<th>Positive Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Environment</strong></td>
</tr>
<tr>
<td>higher population density (city core rather than suburbs)</td>
</tr>
<tr>
<td>higher housing density</td>
</tr>
<tr>
<td>mix of land uses (such as residential and retail)</td>
</tr>
<tr>
<td>street design with more connectivity (rather than cul-de-sacs)</td>
</tr>
<tr>
<td>availability of public transit</td>
</tr>
<tr>
<td>walking and biking infrastructure (such as sidewalks and bike lanes)</td>
</tr>
<tr>
<td><strong>Psycho-Social Environment</strong></td>
</tr>
<tr>
<td>safety from crime</td>
</tr>
<tr>
<td>safety from traffic</td>
</tr>
<tr>
<td>absence of social disorder</td>
</tr>
<tr>
<td>aesthetics (including trees and landscape)</td>
</tr>
<tr>
<td>educational campaigns (such as Walk-to-School)</td>
</tr>
<tr>
<td>incentive programs (such as work place reimbursement for transit use)</td>
</tr>
</tbody>
</table>

*Table 1: Determinants of City Walkability*
Percentage of Americans Living Within ½ Mile of a Park, by State

National average: 39%
Findings by State:

Lowest:
  West Virginia  9%

Highest:
  Minnesota  60%
  Hawaii  67%
  District of Columbia  88%

*10 States exceed 50%

make room for pedestrians
Parks Prescription

San Francisco
Albuquerque

- Annapolis MD Parks and Recreation
- South Carolina State Parks
- Sitka AK Nat’l Historic Park
- Indiana Dunes Nat’l Lakeshore
Social Ties & Community

- people who lacked social and community ties were more likely to die in a 9 year follow-up period, and was independent of self-reported physical health status at the study start.
- male heart attack patients classified as being socially isolated and having a high degree of life stress had more than four times the risk of death of the men with low levels of both stress and isolation.
natural & social capital

community gardens - renewal

Parks & People Foundation, Baltimore
“3rd place” & social cohesion

Future Research & Outreach Opportunities?
Restorative Nature Beyond the City?

evidence about the importance of ‘nearby nature’
Nature :: From Aesthetics to Necessity in Cities

Research Reviews

Green Cities: Good Health

www.greenhealth.washington.edu


Urban Green :: Public Health & Well Being

> 2,600 articles

- correlation to causal mechanisms
- dosage? how much, how often
- green space attributes
- multi-tasking green space; better integration with gray/green infrastructure
- benefit to cost assessments
- lifecycle & cultural specifics

Better Knowledge . . . .
Summary

- 40 years of research in social sciences and human dimensions
- Urban nature is profoundly important for human habitat – a wealth of public goods
- More than beauty, aesthetics, and ‘pretty’
- Direct and indirect economic values for
  - Homeowners
  - Neighborhoods
  - Local government
Human Dimensions of Urban Forestry and Urban Greening

Featuring research on peoples' perceptions and behaviors regarding nature in cities.

Nature and Consumer Environments
Research about how the urban forest influences business district visitors.

Trees and Transportation
Studies on the value of having quality landscapes in urban roadways.

Civic Ecology
Studies of human behaviors and benefits when people are active in the environment.

Policy and Planning
Integrating urban greening science with community change.

Urban Forestry and Human Benefits
More resources, studies and links . . .

Green Cities, Good Health
Human health & well-being research

Projects Director
Kathleen L. Wolf, Ph.D.

www.naturewithin.info