Trees for Better Human Habitat: the evidence of health benefits

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Seminar at Barcham Trees
September 19, 2014
WHO health definition

a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity (1946)

science & evidence re: environment role of city trees & forests? not a panacea, but important!
Restorative Nature
Beyond the City?
evidence about the importance of ‘nearby nature’
City Trees, Urban Forests for Health . . . . . Habitat

scientific evidence
health & well being benefits
life course concept
‘cradle to grave’
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

Richard Louv - Last Child in the Woods
adult support of nature experience
adult support of nature experience
http://www.treeclimbing.jp/
physically disabled & tree climbing!
recreational tree climbing – youth therapy
School & Learning
Green High School Campuses

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

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

ART Design

Elements

- being away
- ‘soft’ fascination
- extent
- compatibility
the better office cubicle!

bottom line = $$ benefits of trees & nature
Trees & Crime Reduction

- trees in the public right of way are associated with lower crime rates
  - smaller, view-obstructing trees are associated with increased crime
  - larger trees are associated with reduced crime

Donovan & Prestemon. 2012. *Environment and Behavior*
Green & Crime Reduction

- vacant lot greening in Philadelphia (4 sections)
  - consistent reductions in gun assaults across 4 sections
  - consistent reductions in vandalism in 1 section

Branas et al. 2011. *American Journal of Epidemiology*
EAB Tree Loss & Public Health

1990 to 2007, 1,296 counties in 15 states
infected areas vs. no bugs
15,000 more deaths from cardiovascular disease
6,000 more deaths from lower respiratory disease
controlled for demographic, human mortality, and forest health data at the county level

Toledo, Ohio in 2006, pre EAB

2009, EAB in neighborhood

photos: Dan Herms, Ohio State University
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
Obesity :: global epidemic
secondary, chronic disease

ESTIMATED PREVALENCE OF DIABETES IN 2007

Map shows type 1 and type 2 diabetes. Obesity and type 2 diabetes are causally linked.
# 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*
Canine constitutional.

A brief walk in the park helps Harry III relieve his seasonal dog boredom. His owners, Children residents Carla and Stephen, got up early to give him 5-year-old Valentine his regular medicine. They typically walk or ride in Berkeley Park.
make room for pedestrians
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

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

40 controls
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

hospital healing gardens: 
patients; family and friends; professional staff

health care $$ savings
Legacy Good Samaritan Medical Center
Stenzel Healing Garden 1997
Rehabilitation Institute of Oregon
Oregon Burn Center Garden
Hospital Staff – Respite and Support
Nature: A stress coping resource for employees 24-7

thanks to Teresia Hazen for slides
Atlanta Regional Council
elder care and services summit

September 2013
record attendance
service agencies
food programs
care facilities
medical community
Elders & Horticulture Therapy
Summary

nearly 40 years of health evidence
diverse health benefits
associated with diverse nearby nature
from cradle to grave!
expand partnership & collaboration
Nature :: From Aesthetics to Necessity in Cities

BIOPHILIC CITIES
Integrating Nature into Urban Design and Planning

TIMOTHY BEATLEY

Foreword by E. O. Wilson

The Biophilia Hypothesis

Stephen R. Kellert
Edward O. Wilson


What Health or Social Benefits Evidence Do You Share?

How do clients, residents, stakeholders, decision-makers respond?
Where do we find the evidence?

research sources & methods
Finding that study . . . . . .
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

www.greenhealth.washington.edu
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 distance and a longer time to visit a district having high quality trees, and spend more time there once they arrive.
Metro Nature :: Human Health & Well Being

> 2,900 articles in database

% distribution of entire database
Metro Nature & Health Evidence Framework
Eco-Health Relationship Browser

You are here: EPA Home ➤ Research ➤ Health Research ➤ Eco-Health Relationship Browser

- Open the Relation Browser in a new window
- Copy of all the Relation Browser data (XML)
- Copy of all the Relation Browser data (PDF) (16 pp, 475KB, About PDF)

Bibliography

Eco-Health Relationship Browser: Public Health Linkages to Ecosystem Services

Urban Ecosystems

Click a topic bubble or choose a topic from the dropdown list above.
Hover over linkages (*) to view relationship between elements.

Details

Description
An urban ecosystem is a dynamic system that contains both built and natural elements on a regional scale. In an urban ecosystem, human, plant and animal communities are situated within an urban environment. Urban ecosystems can mimic the function of natural ecosystems and thus provide their own important ecosystem services that contribute to human well-being in those urban areas. Various green environments such as shade trees, 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 evaporating heat, absorbing impervious...
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
- Water Regulation
- Water Filtration
- Promotion of Physical Activity
- Heat Mitigation
- Engagement with Nature

--- Health Outcome ---

- ADHD
- Aggression
- Anxiety
- Arthritis
- Asthma
- Birth Outcomes

Details:

An urban ecosystem is a natural environment that functions similar to an urban system. The urban ecosystem is composed of plants, animals, and the interactions that occur between them. The urban ecosystem provides critical services that contribute to human health and well-being. 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.

Citations of Key Studies

Guidotti, 2010; Hancock, 2002
Eco–Health Relationship Browser Bibliography

You are here: EPA Home » Research » Health Research » Eco–Health Relationship Browser » Eco–Health Relationship Browser Bibliography

Eco–Health Relationship Browser Bibliography

To show or hide an entry's abstract, click on the citation. Click blue citations to link to website source.


Research Methods

• hypothesis/research question, data collection, analysis
• survey/interview self report
• quasi-experiment, pre/post tests
• ‘natural experiment’
• experimental – laboratory or *in situ*
Research about positive human response to nature?

What communications tools or materials would help deliver the messages of health, wellness, and well-being?
Positive Response to Trees!

What is the Economic Value?
Forest Econ 101
Economic Value of Urban Green Challenges!

Forest Products Industry
= market goods
excludable
identifiable ownership
expenses-revenues-profits

Trees/Green in Cities
= public goods
non-excludable
multiple “owners”
expenses-returns?-profits?
# 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>

Green Cities: Good Health > Local Economics
# Tree Retention In Development

<table>
<thead>
<tr>
<th>Value</th>
<th>Increase</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18%</td>
<td>building lots with substantial mature tree cover</td>
</tr>
<tr>
<td></td>
<td>22%</td>
<td>tree-covered undeveloped acreage</td>
</tr>
<tr>
<td></td>
<td>19-35%</td>
<td>lots bordering suburban wooded preserves</td>
</tr>
<tr>
<td></td>
<td>37%</td>
<td>open land that is two-thirds wooded</td>
</tr>
<tr>
<td>Value</td>
<td>Increase</td>
<td>Condition</td>
</tr>
<tr>
<td>-------</td>
<td>----------</td>
<td>-----------</td>
</tr>
<tr>
<td></td>
<td>10%</td>
<td>inner city home located within 1/4 mile of a park</td>
</tr>
<tr>
<td></td>
<td>17%</td>
<td>home near cleaned-up vacant lot</td>
</tr>
<tr>
<td></td>
<td>20%</td>
<td>home adjacent to or fronting a passive park area</td>
</tr>
<tr>
<td></td>
<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 & Bury. 2010
*Landscape and Urban Planning*
invest from the ground up!
trees & retail districts

multiple studies

Trees & Retail Environments Research
social science of consumer behavior

‘atmospherics’
1. Place Perceptions
   - Place Character
   - Interaction with Merchants
   - Quality of Products

2. Patronage Behavior
   - travel time, travel distance
   - duration & frequency of visits
   - willingness to pay for parking

3. Product Pricing
   - higher willingness to pay for all types of goods
   - higher in districts with trees – 9-12%
Trees & Shopper Environments Research

• Research Questions •
  trees and visual quality?
  trees and consumer behavior?
  trees and product pricing?

• Methods:
  mail out/in surveys
  national or local sample
  residents/nearby city residents

partners: U of Washington, NGOs, business organizations funded by USDA Forest Service
Image Categories (sorted by ratings)

Pocket Parks
mean 3.72
(highest)

Full Canopy
mean 3.63

Scale: 1=not at all, 5=like very much, 26 images
Enclosed Sidewalk
3.32

Intermittent Trees
2.78
No Trees
mean 1.65 (lowest)
(high - 3.72)
freeway roadside
freeway roadside
freeway roadside
strip malls
vegetation
edited in
shopper survey
Companies stage an experience when they engage customers in a memorable way.
digging deeper

- attribution theory
- neatness counts
- trees, accessory vegetation, sidewalk care = curb appeal
- tree planting or maintenance upgrade = signal of change
- use landscape character to identify the district
Nature and Consumer Environments

Shoppers are increasingly interested in the experience of shopping, as well as the goods and services they expect to purchase. A series of studies has investigated associations between the urban forest and people’s response to shopping settings.

These studies show that providing for trees in the streetscape is an important investment for a business community. The presence of a quality urban forest positively influences shoppers’ perceptions, and probably, their behavior. The information below includes research studies, a booklet to help create and sustain beautiful streetscapes, and a list of all presentations, fact sheets, and publications.

Studies

Trees and Business - Growing Together A National Research Program

Trees provide environmental benefits in cities, but also contribute to business districts. These findings have been consistent across large, small, and medium-sized cities. The most positive consumer response is associated with urban forests where an overarching tree canopy helps create a “sense of place.” The results across several research studies. Details of research found in sections below.

www.naturewithin.info
Austin, TX
Metro Nature for Public Health

health & well being benefits
translated to economic terms
‘monetized’
Caveats and Conditions

- shhh! still under peer review for publication
- life course focus
- subset of all metro nature findings
- the best current valuation prospects
- numbers rather small – why?
Valuation Challenges . . . .

- little crossover of natural resources and public health methods
- spotty local health data sources
- equivalent geographic scale of datasets:
  - < 1m for vegetation
  - neighborhood or block for health
- precision of vegetation assessment . . . (may need more than canopy)
Local Economics

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- 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.\textsuperscript{9}

- A study found 7\% higher rental rates for commercial offices having high quality landscapes.\textsuperscript{14}

- Shoppers claim that they will spend 9\% to 12\% more for goods and services in central business districts having high quality tree canopy.\textsuperscript{34}

- Shoppers indicate that they will travel greater distance and a longer time to visit a district having high quality trees, and spend more time there once they arrive.\textsuperscript{34}
Metro Nature :: Human Health & Well Being

> 2,900 articles in database

% distribution of entire database
Elements of Economic Valuation

• what is the benefit?
• who experiences nature and gets benefit?
• what is the green condition or situation that provides benefit?
• scale of value question (community, province/state, nation)
• what are the costs/income gained/lost associated with the benefit?
### Economic Valuation

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Metro Nature</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn Birth Weight</td>
<td>canopy cover and birth weight</td>
<td>more tree canopy - fewer small for gestational age babies</td>
</tr>
<tr>
<td>Attention Deficit Hyperactivity Disorder</td>
<td>greener play areas vs built outdoor or indoor settings</td>
<td>reduced symptoms potentially reducing medication</td>
</tr>
<tr>
<td>School Performance</td>
<td>green views from classrooms and cafeteria</td>
<td>reduced dropout rate - average annual income</td>
</tr>
<tr>
<td>Crime Reduction</td>
<td>trees and lawn in outdoor common areas</td>
<td>reduced violent and non-violent incidence and costs</td>
</tr>
<tr>
<td>Cardiovascular Disease</td>
<td>presence of residential tree canopy</td>
<td>reduced incidence or severity of cardiovascular disease</td>
</tr>
<tr>
<td>Alzheimer’s Disease</td>
<td>wander garden in care facility</td>
<td>reduced medications for patients</td>
</tr>
</tbody>
</table>

Total Value (2012, U.S.) - in peer review
Benefits Science
OR
Economic Values

Which is the better message, and when?
Vegetation Assessment for Public Health

health & well being benefits
evaluating the forest ecosystem
urban forest benefits
Eco (UFORE)
Streets (STRATUM)
Hydro
Vue
Improving Air Quality

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

Image courtesy of the Center for Urban Forest Research
Urban Heat Island Effect
studies by NASA & EPA

urban trees = mitigation
more than trees . . . nature & health evidence
Urban Tree Canopy Assessment

i-Tree analysis or satellite data

City of Seattle
Top Down Mapping
plus
understory vegetation
for human habitat

school yard landscapes
forest = silviculture
forest = ecosystem
Remote Sensing-LIDAR

Remote Sensing-LIDAR

LiDAR response to built versus vegetative surfaces.

credit: Qian-Yi Zhou, Stanford University
Veg Assessment Explorations
Veg Assessment Explorations

ground view

LIDAR point cloud
Tree, Forest & Metro Nature Assessment

what is your community using?
what are the products?
Science and the Sacred for Better Human Habitat?

another dimension
Abraham Maslow
Hierarchy of Needs
public green spaces that please the eye, nourish the soul, and help renew communities
evidence of gardens & healing
Effects of nature window view on recovery from surgery (Roger Ulrich, 1984)

- Shorter stays
- Less pain
- Fewer minor complications
- Better emotional well-being
hospital healing gardens:
patients; family and friends; professional staff

health care $$ savings
healing gardens
soothing
distracting
calm focus
Nature Sacred ::
Open Spaces Sacred Spaces

grants program – integrated design & research
Portland OR Legacy Hospitals
under construction – healing garden
Portland OR Legacy Hospitals (credit: TKF Foundation)
grants program – integrated design & research
Portland OR Legacy Hospitals
place, design & mindfulness
Design Elements

NatureSacred :: Open Spaces Sacred Places
portal :: path :: surround :: destination
portal :: path :: surround :: destination
science & sacred intersection?
Nature and Mindfulness

- focus
- soft fascination
- undirected attention
Mindfulness/Meditation Training

- meta analysis; clinical/non situations
- focus on moment-to-moment experience and mental awareness
- more veridical perception (reality check)
- reduce negative affect
- improve vitality and coping
- medical symptoms & sensory pain

Mindfulness/Meditation Training

- healthy workplace employees
- 8 week mindfulness training
- brain electrical activity – positive affect
- brain activation – reduce stress event response
- more antibodies after influenza vaccine = better immune function

Davidson et al. 2003. Alterations in Brain and Immune Function Produced by Mindfulness Meditation. Psychosomatic Medicine
NatureSacred :: bench journals

> 10 years
> 100 gardens
> 10,000 journal entries
Mindfulness :: Journal Analysis

Big Summary

- 40 years of evidence for human health & wellness provided by nearby nature
- what are the deeper experiences?
- how do we measure them (outcomes and economic value)?
- how much time in nature is needed?
- science and sacred – an important blend
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 roadsides.

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.

Green Cities: Good Health
human health & well-being research

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

Projects Director
Kathleen L. Wolf, Ph.D.

www.naturewithin.info