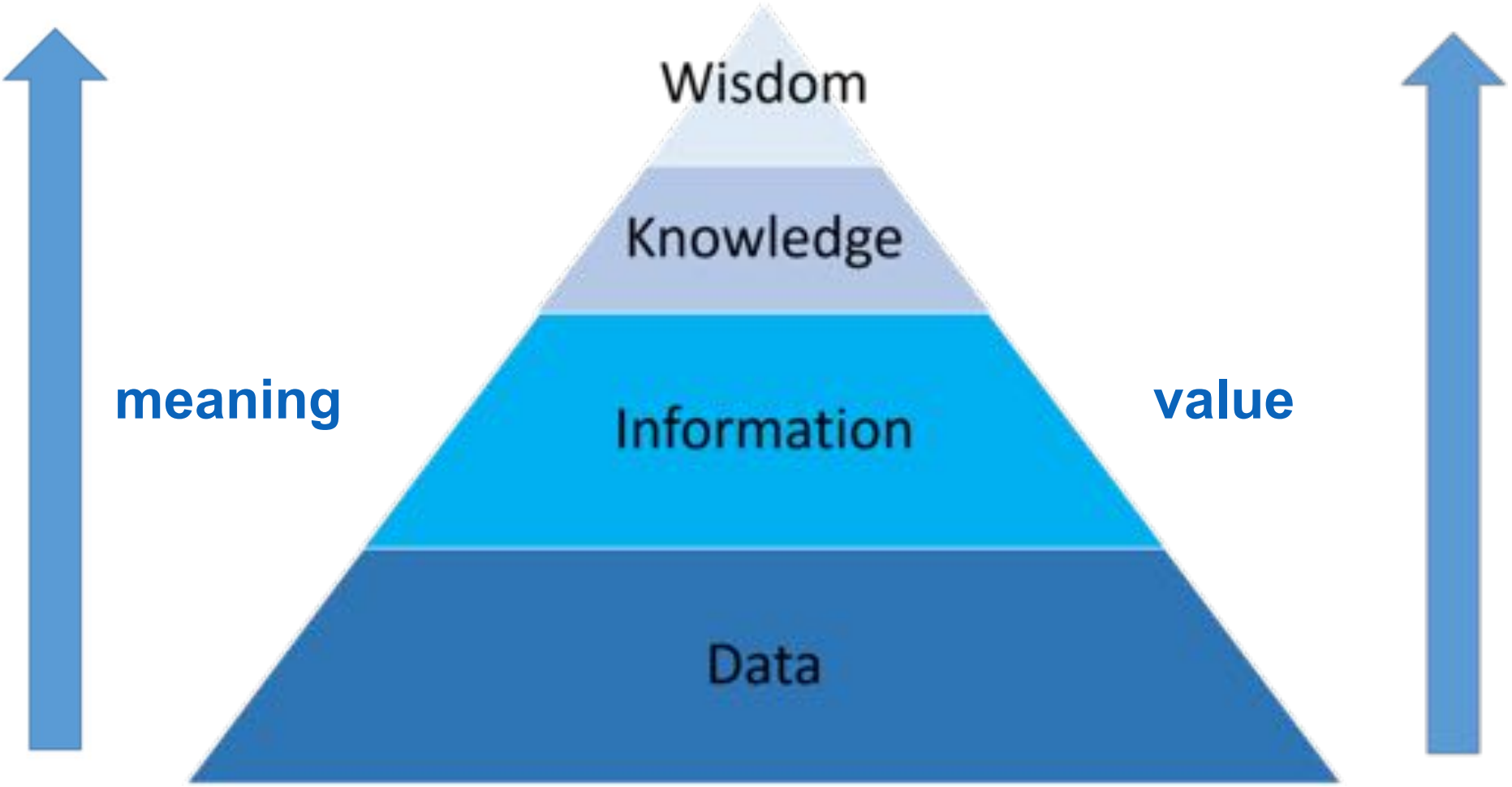
City Trees & Human Health :: Evidence to Action

Kathleen Wolf, Ph.D.
Research Social Scientist

University of Washington (Seattle)
School of Environmental and Forest Sciences
College of the Environment

Good Health Grows on Trees
30 May 2019


Wisdom
Knowledge
Information
Data
meaning
value

Outline

1. History :: Environmental Health :: Urban Sustainability

2. Nature as Social Determinant of Health

3. Evidence = Shift (policy)

Environmental Health

Rachel Carson (1907-1964)

1962

A Remarkable Career

- aquatic biologist, U.S. Bureau of Fisheries
- 1950s full time nature writer
- 1951 Sea Around Us, National Book Award
- The Edge of the Sea, Under the Sea Wind
- 1962 Silent Spring, national pesticide policy
- launched grassroots environmental movement
- creation of the Environmental Protection Agency

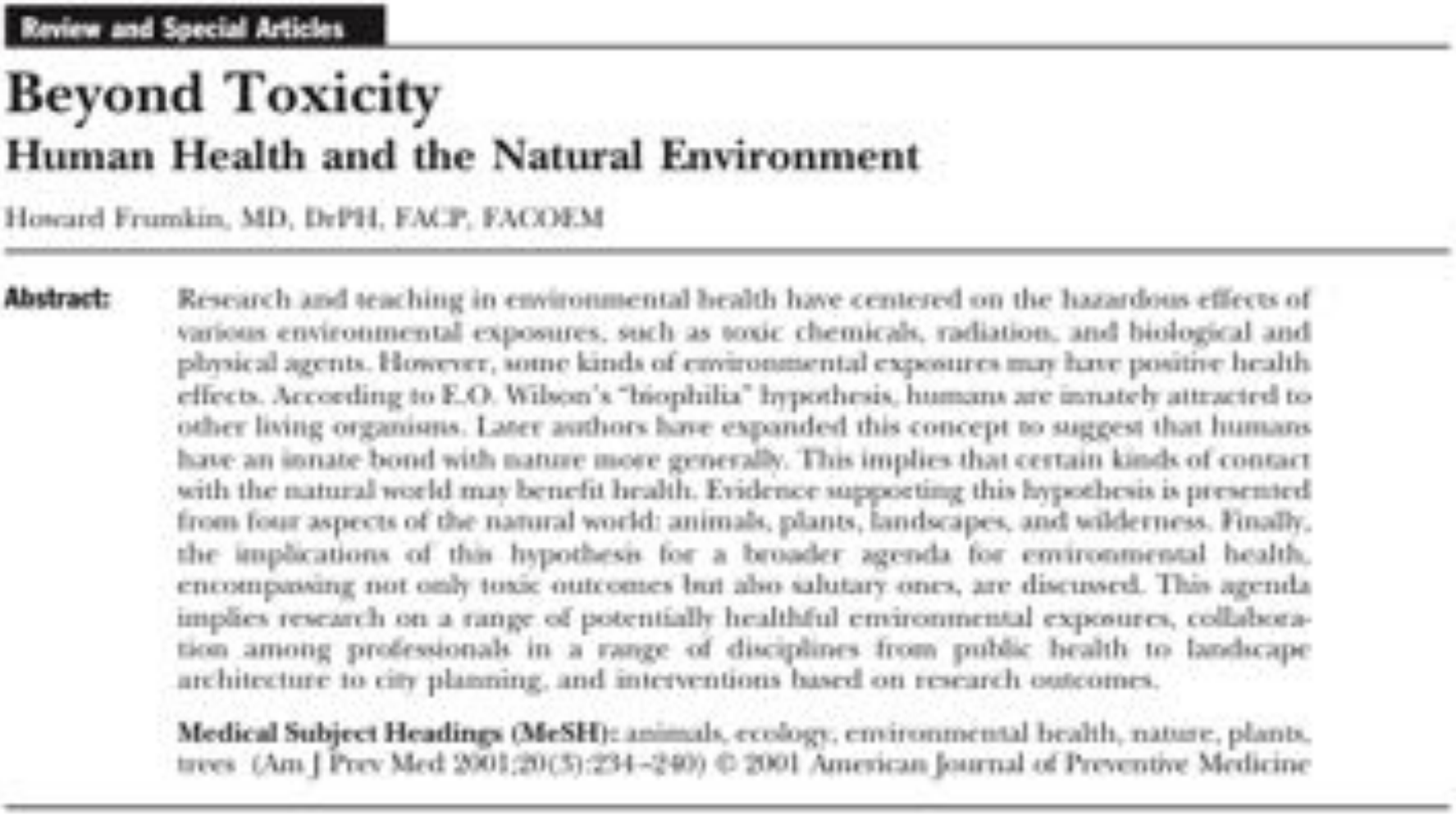
Pervasive Pesticides

Environment = Toxin, Risk

Love C
Niagra

iver, OH

Environment & Health Benefit



Review and Special Articles

Beyond Toxicity

Human Health and the Natural Environment

Howard Frumkin, MD, DrPH, FACP, FACOEM

Abstract: Research and teaching in environmental health have centered on the hazardous effects of various environmental exposures, such as toxic chemicals, radiation, and biological and physical agents. However, some kinds of environmental exposures may have positive health effects. According to E.O. Wilson's "biophilia" hypothesis, humans are innately attracted to other living organisms. Later authors have expanded this concept to suggest that humans have an innate bond with nature more generally. This implies that certain kinds of contact with the natural world may benefit health. Evidence supporting this hypothesis is presented from four aspects of the natural world: animals, plants, landscapes, and wilderness. Finally, the implications of this hypothesis for a broader agenda for environmental health, encompassing not only toxic outcomes but also salutary ones, are discussed. This agenda implies research on a range of potentially healthful environmental exposures, collaboration among professionals in a range of disciplines from public health to landscape architecture to city planning, and interventions based on research outcomes.

Medical Subject Headings (MeSH): animals, ecology, environmental health, nature, plants, trees (Am J Prev Med 2001;20(3):234–240) © 2001 American Journal of Preventive Medicine

American Journal of Preventive Medicine, 2001

the Sanitary to Sustainable City

sanitary is efficient and hygienic
supply & removal
    of materials and services
reconnect natural systems
green infrastructure possibilities

Industrial Age – city squalor

credit: BlendSpace

credit: blogs.isb.bj.edu.cn

Filthy Cities!

08/04/2005

Baltimore: Public Works Museum
STORM DRAIN

stormwater retention

Stormwater Management

Thornton Creek Water Quality Channel (Seattle, SvR Design)
1 hectare, treats runoff from 275 hectares (1 hectare = 2.47 acres)

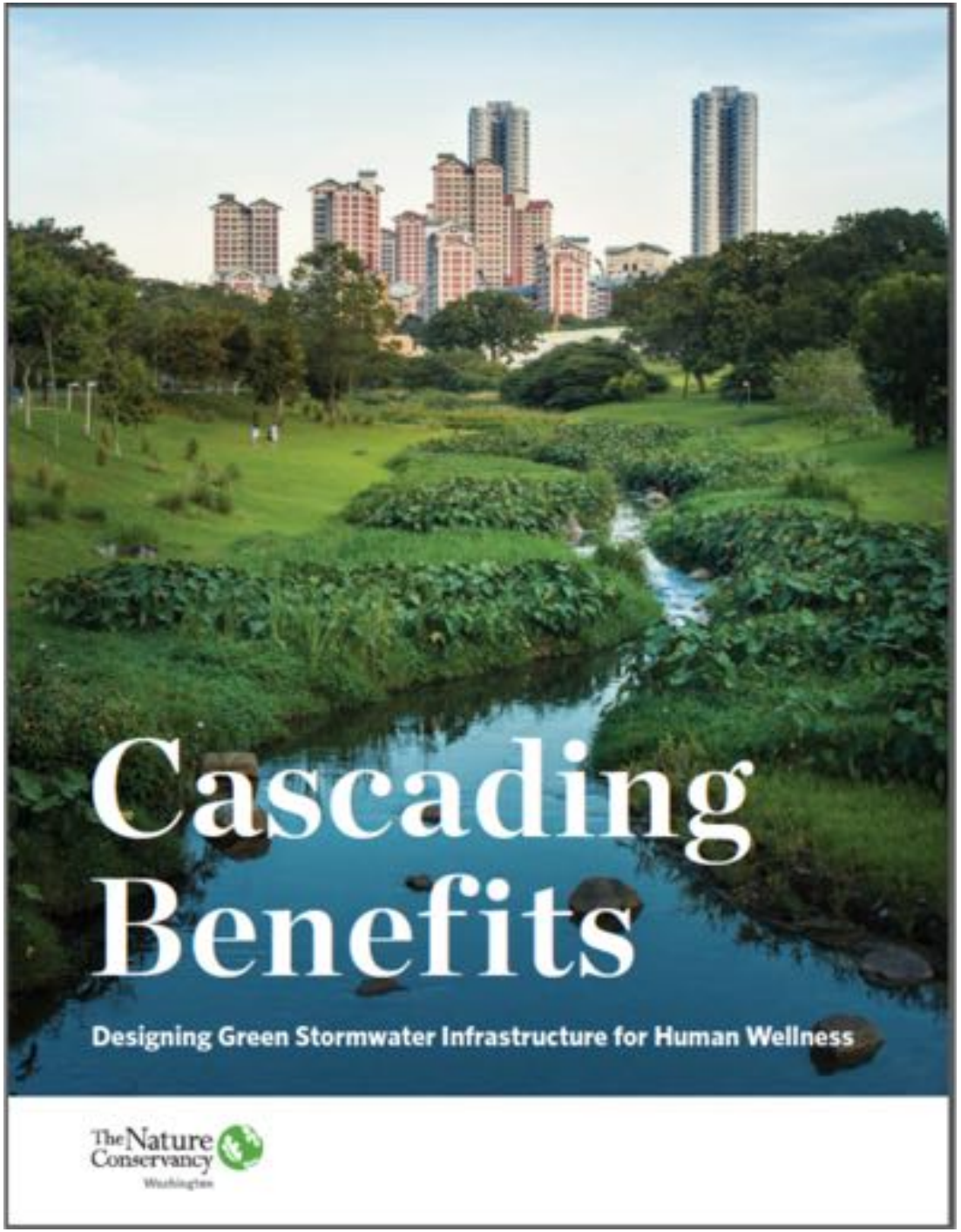
the Chenoggye freeway

Seoul, South Korea

~ 1970-2005

Cheonoggyecheon Stream Restoration

8.4 km, $900 M



co-author:

co-author & printing:

The Nature Conservancy

sponsors:

Willamette Partnership

Oregon Public Health Institute

The Green Infrastructure Leadership Exchange

Outline

1. History :: Environmental Health :: Sanitary to Sustainable Cities

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2. Nature as Social Determinant of Health

City Nature Settings

NEARBY NATURE INCLUDES A VARIETY OF SPACES AND PLACES

IMAGE BY MIG / SvR

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;
Hystad et al., Env Health Perspectives 2014

Bloomfield et al. 2016 Perspectives in Public Health

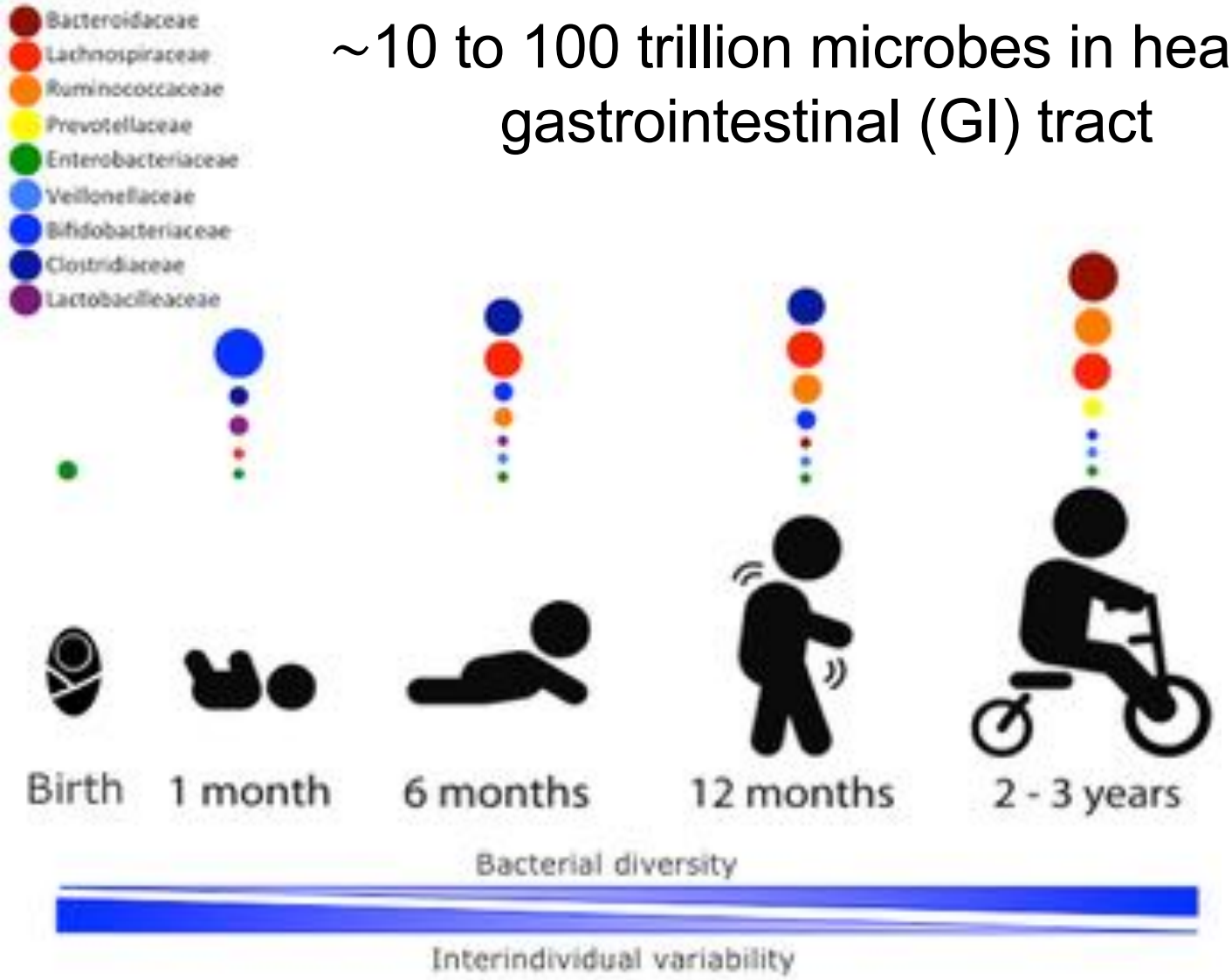
Healthy Microbiome

- control obesity & asthma
- boost immune function
- improve mental health

put aside
the
Hygiene
Hypothesis

need contact with ‘Old Friends”

~10 to 100 trillion microbes in healthy gastrointestinal (GI) tract



intestinal microbiome development

Arrieta et al. 2014. Frontiers in Immunology

Eat Dirt!

Trees & Physical Activity

- school children in cities grades 6 to 8
- relationship of tree cover to outside-of-school physical activity
- **5% increase in treed area cover =**
  5% increase in free-time physical activity

Janssen et al. 2015. International Journal of Behavioral Nutrition and Physical Activity

public health officials
moderate activity
recommendations
parks, active living, active transit

public health officials
moderate activity
recommendations
parks, active living, active transit

Donovan et al. 2013. Journal of Preventive Medicine

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

photo credits: Dan Herms, Ohio State U

Sacramento Study :: LIDAR x CHIS data

7,900 adults, 250 m buffer, covariates

more tree cover

= better overall health

= better social cohesion

Ulmer et al. 2016. *Health & Place*. Multiple health benefits of urban tree canopy: The mounting evidence for a green prescription.

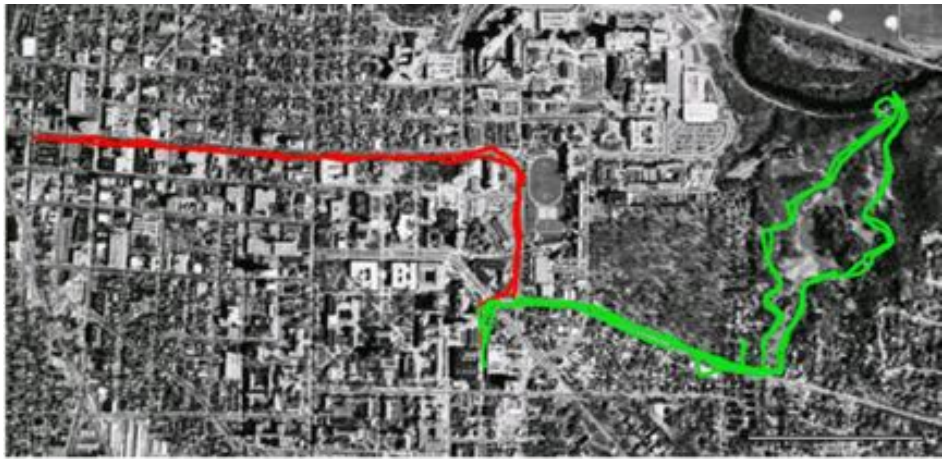
Improving Depression

20 adults with major depression
walk in a park setting and a built setting

- 50-minute walks one week apart
- before-after testing:
  - Mood: Positive and Negative Affect (PANAS)
  - Cognition: Backward Digit Span (BDS)

Berman et al. 2012. *Journal of Affective Disorders*

cognitive and affective improvements after walking in a nature setting



Neighborhoods with Trees

10 more trees on a city block?

health benefits comparable to $10,000 household income increase OR being 7 years younger

Kardan et al., 2015, Scientific Reports

Alzheimer's Disease & Dementia

Provide wander gardens & horticulture therapy

- 10.5% reduction in amount of medications used in dementia facility
- 30% fewer falls, accompanied by a reduction in fall severity

Detweiler et al. 2009. *American Journal of Alzheimer's Disease and Other Dementias*

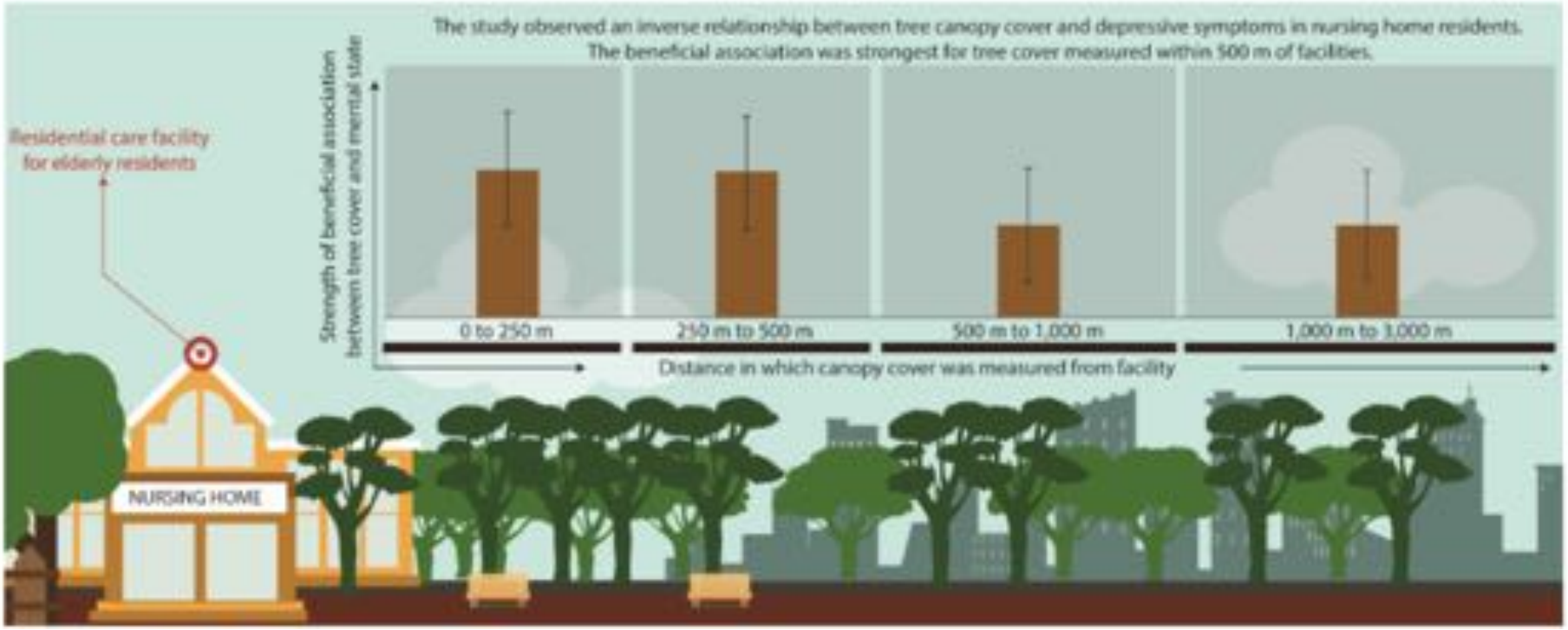
Tim Lynch Associates

www.rph.org/eden.html

Urban Forestry & Urban Greening
Volume 41, May 2019, Pages 23-32

Tree cover shows an inverse relationship with depressive symptoms in elderly residents living in U.S. nursing homes

Matthew H.E.M. Browning [a, b], Kangjae Lee [b], Kathleen L. Wolf [c]



City Trees & Human Health

newborn & infant health

increased physical activity for kids

overall adult health

social cohesion

respiratory & cardiovascular health

reduced depression

elder care improvements

Data Story: Human Health Benefits Across the Life Cycle

WHO Health Definition

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

Social Determinants

Green Cities: Good Health

www.greenhealth.washington.edu

Sponsors:

USDA Forest Service,
(U&CF Program + Pacific NW Research)
University of Washington
NGO partners

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

Research Reviews & Summaries

Community Building
Local Economics
Place Attachment & Meaning
Crime & Fear
Safe Streets
Active Living
Reduced Risk
Wellness & Physiology
Healing & Therapy
Mental Health & Function
Work & Learning
Culture & Equity
Lifecycle & Gender

Local Economics

RSS Feed Print

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.[1,2] Then, it shows how nonmarket valuations can support local decision-making.

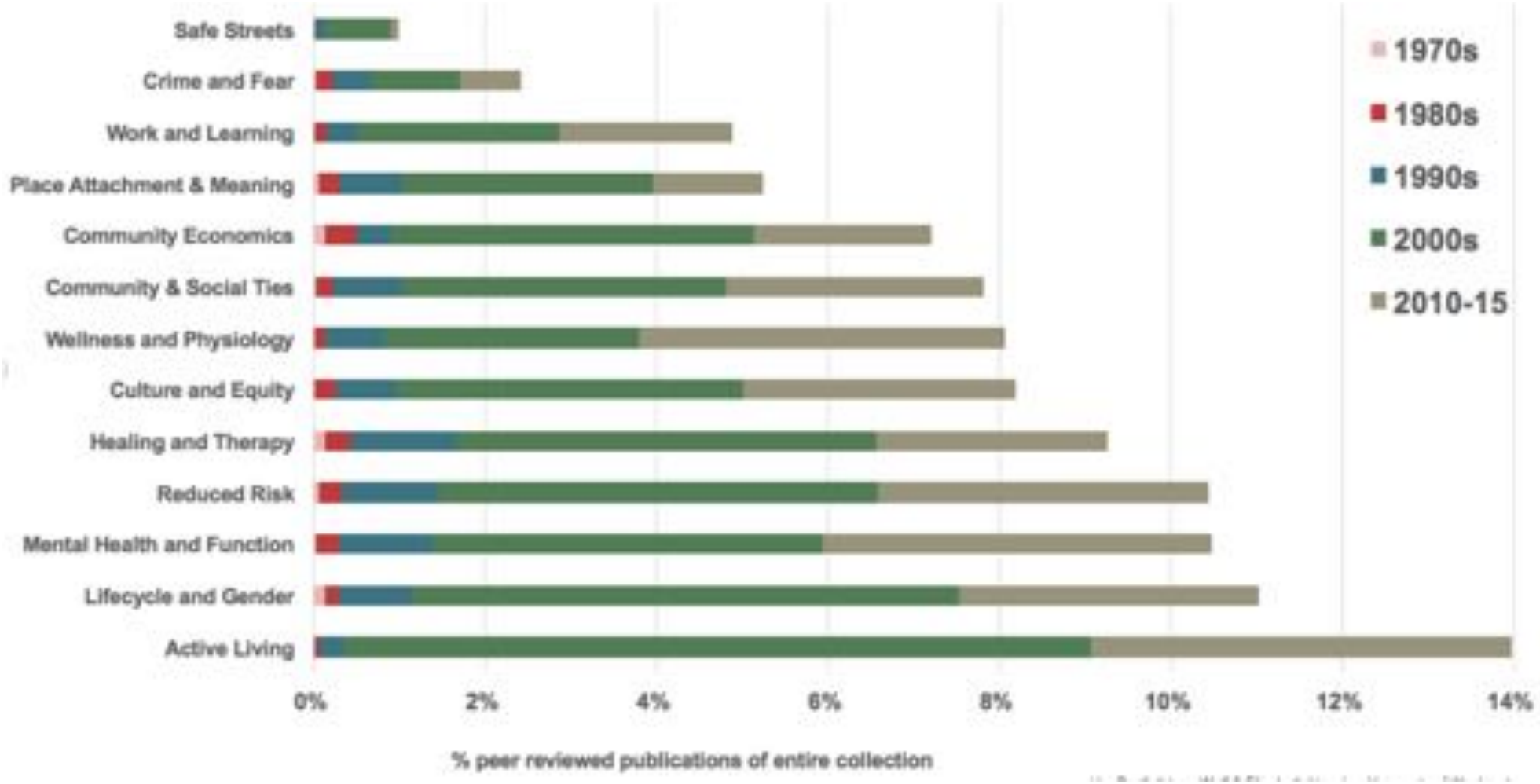
street trees boost market value of houses, providing tax revenue for communities

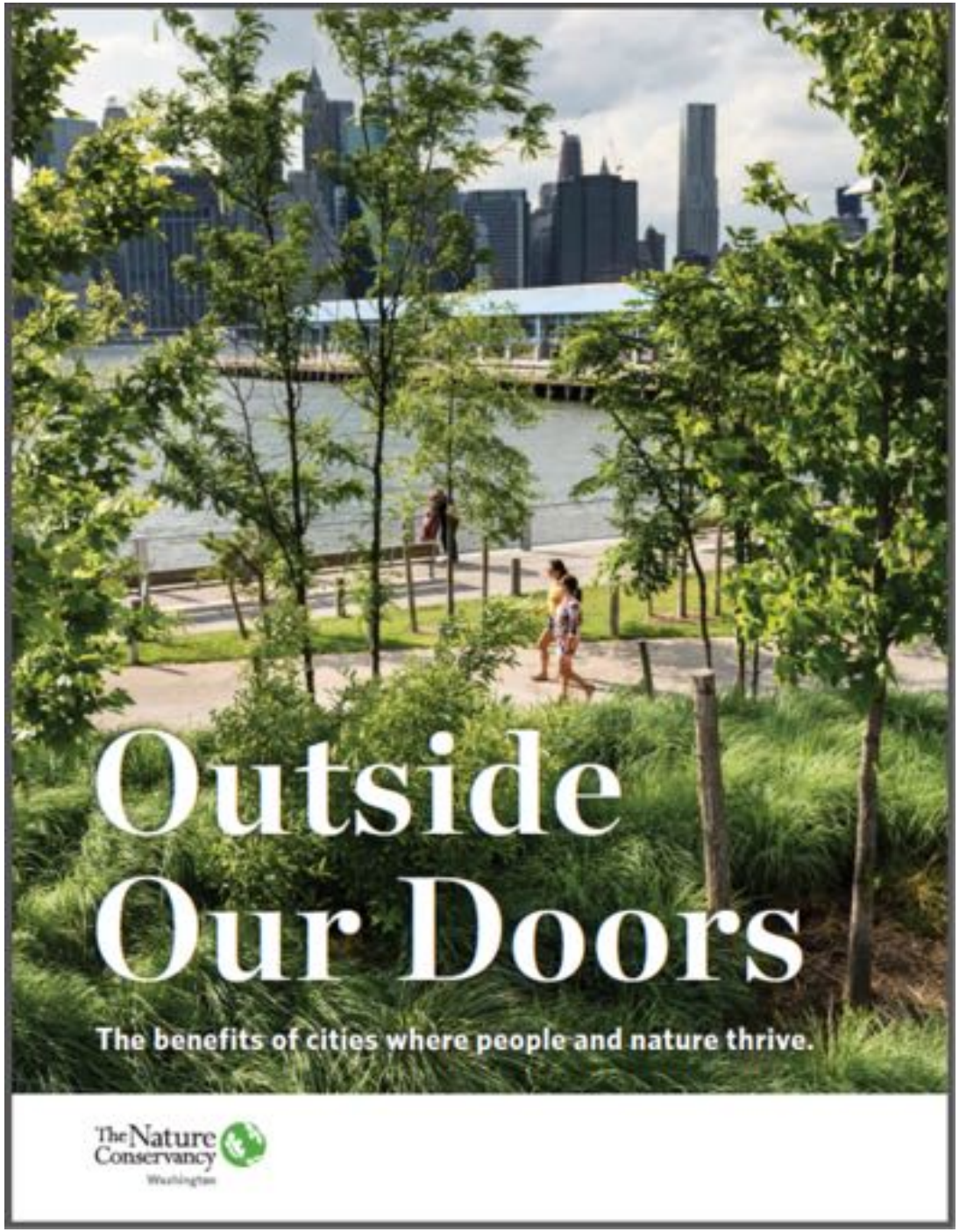
Fast Facts

- 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.[9]
- A study found 7% higher rental rates for commercial offices having high quality landscapes.[14]
- Shoppers claim that they will spend 9% to 12% more for goods and services in central business districts having high quality tree canopy.[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.[34]

Green Cities: Good Health

database of >4,500 peer reviewed publications





2016

design: milepost

co-author: FOREST SERVICE U S DEPARTMENT OF AGRICULTURE

co-author & printing: The Nature Conservancy

USDA Forest Service

2018

Outline

1. History :: Environmental Health :: Sanitary to Sustainable Cities

3. Evidence = Shift (policy)

2. Nature as Social Determinant of Health

Policy ‘Shift’

1. **urban forest planning & management**
2. **medicine/public health**
3. **influenced by economics**

Vegetation & Mental Health

- vegetation cover and afternoon bird abundances
- lower prevalence of depression, anxiety, and stress:

  depression, more than 20% cover,

  anxiety, more than 30% cover,

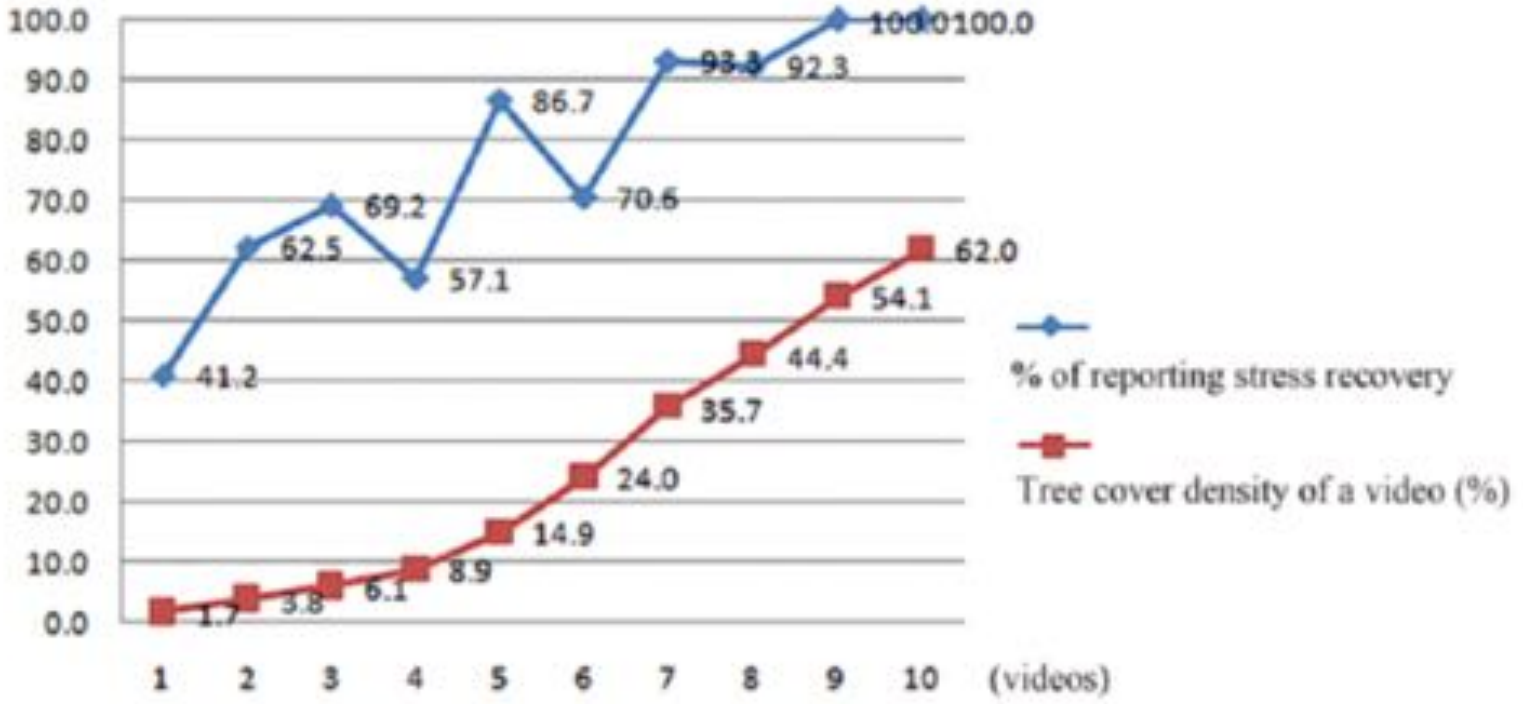
  stress, more than 20% cover

“dose” at which health issue is lower

Cox et al. 2017. BioScience 67, 147-155.

Canopy Cover & Stress

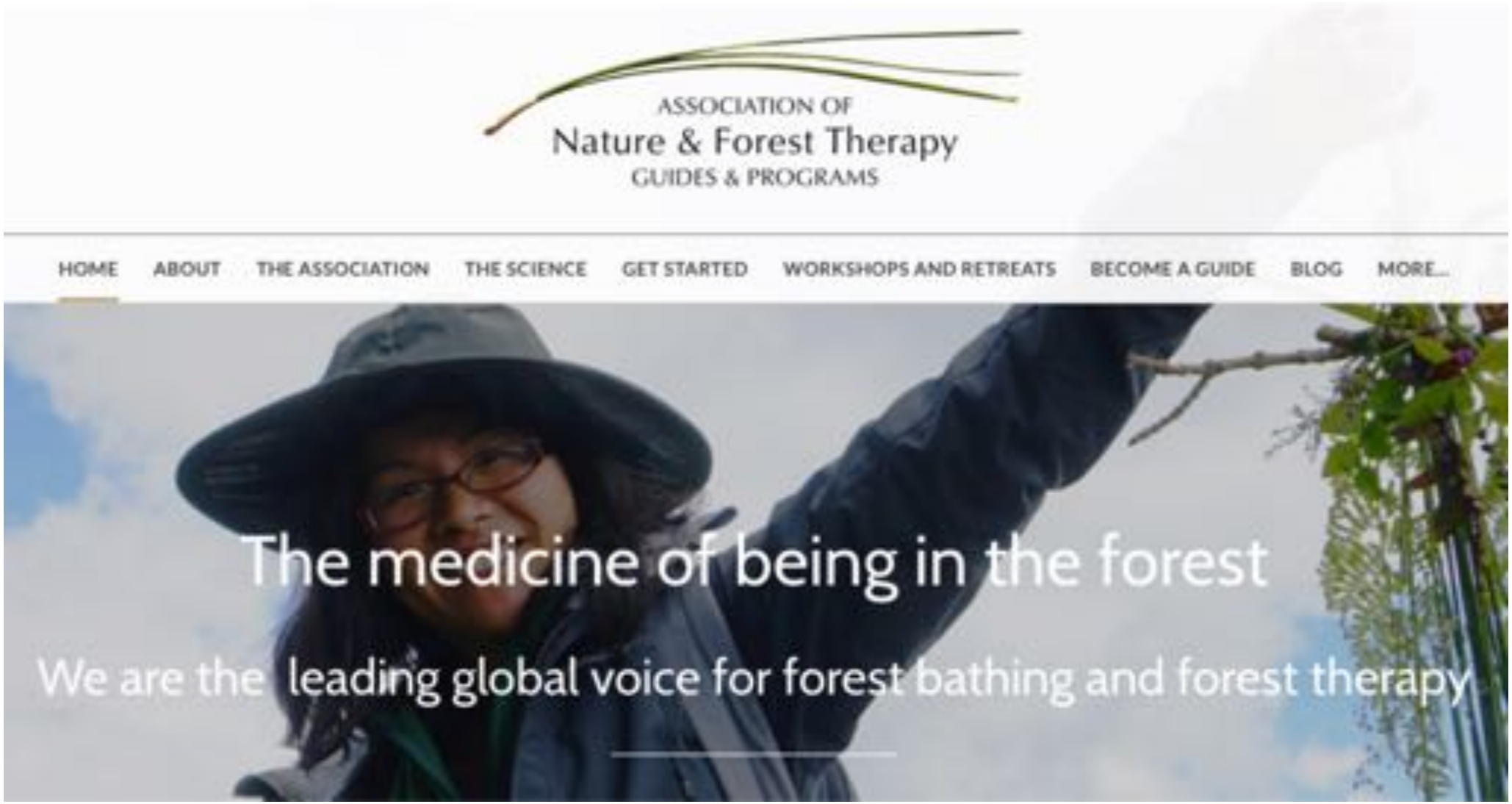
images of canopy cover varied 0-60%



Jiang, et al. 2016. Environment and Behavior 48,607-629.

Shinrin yoku (forest bathing)

- extensive research
- restorative experiences
- workers retirees
- networked system, 52 bases in Japan



Santa Rosa, California

Parks Prescription

Rx for Health

Date: _____

Dr: _____

Name: _____

I recommend:

☐ Walking ☐ Other: _____

_____ minutes a day

_____ days per week

* Health Canada suggests moderate activity of 30 minutes per day | 5 days a week

Benefits of daily activity

- Improve overall physical and mental health
- Maintain a healthy weight
- Reduce the risk of diabetes and other chronic conditions
- Lower cholesterol levels
- Manage stress and anxiety

Signature: _____

doctors of bc

Doctors of BC

Parks Prescription

PARKS Rx

Your Prescription For Better Health

This information is provided for educational purposes and is not to be considered medical advice.

www.REACHforbetterhealth.com/ParksRx

Made possible with funding from the Centers for Disease Control and Prevention

walk with a doc
educate. exercise. empower.

credit: healthy central florida

credit: CNN.com

healthy trees.
happy people.

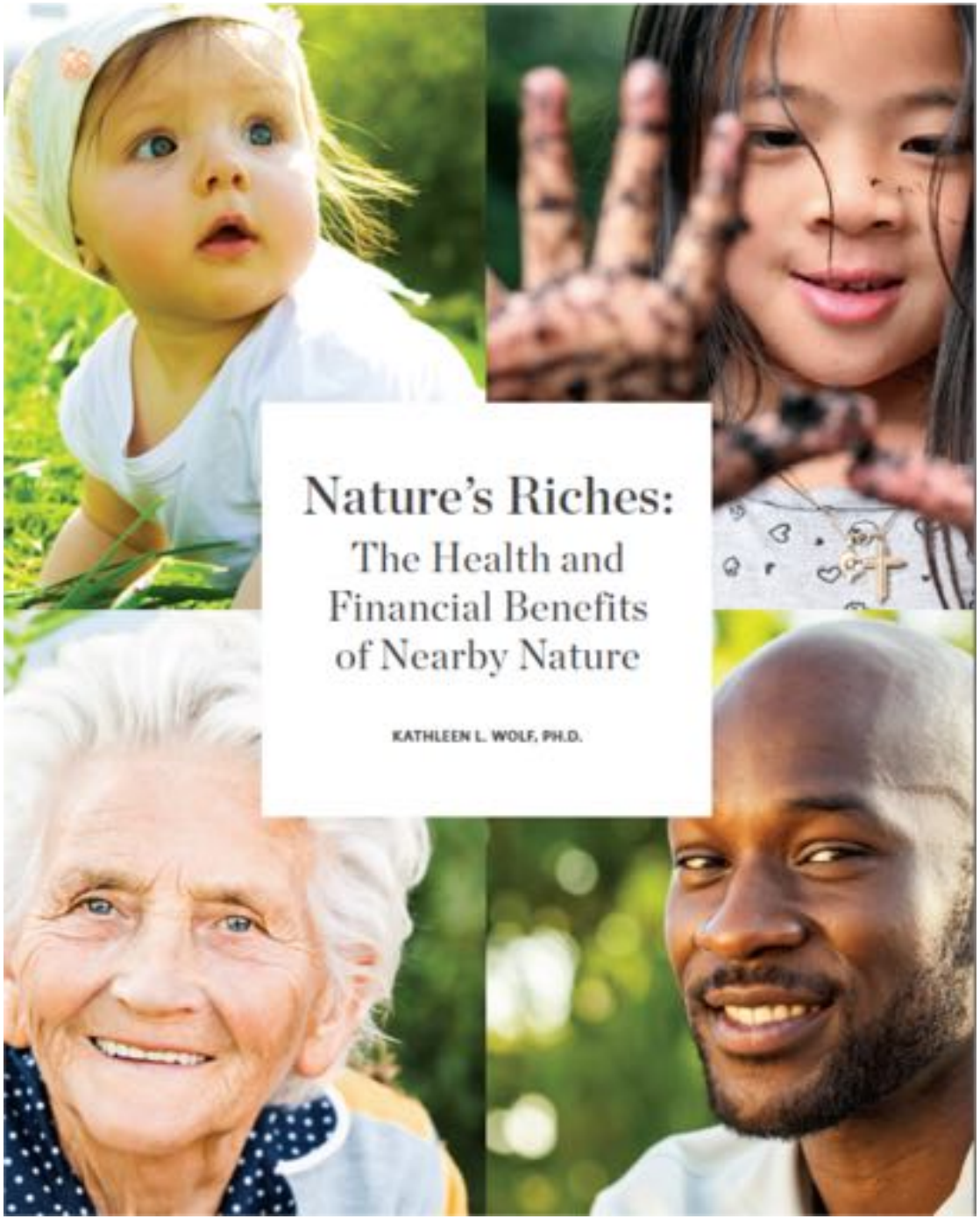
		per 100K pop		per 100K pop
WI Leading Causes of Death, 2017	**Deaths**	**Rate*** **	**State Rank***	**U.S. Rate****
1. Heart Disease	11,680	157.6	26th	165.0
2. Cancer	11,318	153.2	28th (tie)	152.5
3. Accidents	3,746	58.3	17th	49.4
4. Chronic Lower Respiratory Disease	2,834	38.3	34th (tie)	40.9
5. Stroke	2,513	33.5	38th	37.6
6. Alzheimer's disease	2,428	31.6	29th	31.0
7. Diabetes	1,433	19.4	35th	21.5
8. Flu/Pneumonia	974	12.9	39th	14.3
9. Suicide	926	15.4	27th	14.0
10. Kidney Disease	922	12.5	27th	13.0

Causes of Adult Death in Wisconsin?

source: U.S. Centers for Disease Control and Prevention

Economics! U.S dollars

	Wisconsin	Range for States	All U.S
annual per capita spending	$8,702 (2014)		$10,348 (2016)
% of GDP, state & local spending	17.3% (2009)	W VA 23.4% Wyoming 11.2%	17.9% $3.3 trillion (2017)



design: milepost

author: FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

printing: The Nature Conservancy

also in Spanish and Arabic

Nearby nature experiences are important across the entire life cycle, from cradle to grave.

Research about nature benefits and economic value is fairly new. Some of the quantified health benefits of nature in cities are easier to convert to economic value than others. Here are some preliminary valuations - estimated for the entire U.S. on an annual basis.

INFANTS

BIRTH WEIGHT

$5.6M SAVINGS ON ANNUAL HEALTH CARE COSTS.

Birth weight influences long-term childhood health and development, and has been linked to some adult diseases. Low birth weight is associated with both short- and long-term health care costs, such as longer hospital stays and increased illness. Pregnant women that have more tree canopy and green space near their homes generally have babies with healthier birth weights.

IMMUNE FUNCTION

STRONGER IMMUNE SYSTEM LEADS TO REDUCED ILLNESS AND CHRONIC DISEASE ACROSS A LIFETIME.

We are most vulnerable in the early months of our lives, when the body and mind are growing and developing at an astonishing rate. The 'hygiene hypothesis' suggests that early contact with outdoor microorganisms stimulates the development of a healthy immune response.

FAMILY DYNAMICS

IMPROVED FAMILY DYNAMICS, PERHAPS REDUCING MENTAL HEALTH TREATMENT AND COUNSELING SERVICES.

An infant's parents and siblings adjust their lives after a baby arrives, and the changes can bring on stress and anxiety. Nature views and walks help reduce these conditions and improve interactions between people within the household.

Note: All economic values are in 2010 U.S. dollars and are potential annual savings across the entire U.S.

CHILDREN & TEENS

OVERALL HEALTH AND WELL-BEING

INCREASED PHYSICAL ACTIVITY, REDUCED ASTHMA (A LEADING CAUSE OF EMERGENCY DEPARTMENT VISITS, HOSPITALIZATIONS, AND MISSED SCHOOL DAYS), AND REDUCED RISK OF ADULT SKIN CONDITIONS.

Negative conditions in a child's surroundings can create both immediate and ongoing health impacts. Nature is a positive influence, playing in nature helps children develop learning, social, and intellectual skills that improve both health and later life achievement. Green spaces clean the air our children and teens breathe, give them space for moderate to vigorous activity, and shade them from too much sun exposure.

ADHD

$29K-$105K ON MEDICATION SAVINGS PER YEAR.

Millions of children ages 3-17 are treated for Attention Deficit Hyperactivity Disorder (ADHD) in the U.S. Nature exposure is a potential alternative treatment; studies show that activity within nature or green spaces, such as play or just 20 minutes of walking, can reduce symptoms.

FUTURE FINANCIAL SUCCESS

$1.3K INCREASE IN HIGH SCHOOL GRADUATES' LIFELONG ANNUAL INCOMES.

School performance affects both near term self-esteem and long-term success. Having green views from classrooms and common spaces in schools can improve students' capacity to direct attention and feel less stressed. Green high school campus landscapes are linked to higher graduation rates.

ADULTS

DEPRESSION AND STRESS

REDUCES FRUSTRATION, MENTAL DISTRESS AND DEPRESSION DISORDERS, AND IMPROVED BODY IMAGE, SELF-ESTEEM AND LIFE SATISFACTION.

Busy, highly scheduled lifestyles take their toll. Nature experiences reduce stress. Nearly 16 million adults experience major depression each year in the U.S., and mental, behavioral, and neuropsychiatric disorders are a leading cause of disability. Nature experiences support respite and mindfulness for improved mental health, mood, and life function. Improved mental health and function reduces disease treatment costs, and improves worker productivity.

CARDIOVASCULAR DISEASE

$1.2-$1.2B ANNUAL SAVINGS, BASED ON A 1-2% REDUCTION IN HISTORIC EXPENDITURES.

Cardiovascular Disease is the leading cause of premature death in the U.S. People show slightly reduced risk of CVD if their neighborhoods have greater nature coverage (particularly tree canopy), however it is worth noting the majority of studies have focused on men.

CRIME & SAFETY

$916M IN REDUCED COSTS OF CRIME FOR VICTIMS AND PROPERTY OWNERS PER YEAR.

Personal safety and security are important conditions for quality of life. The presence of nature in neighborhoods – community gardens, forest canopy, and landscaped vacant lots – is associated with reduced personal and property crime.

OLDER ADULTS

MOBILITY & QUALITY OF LIFE

$1.7-$2.4B SAVINGS ON HEALTH CARE COSTS FROM FALLS PER YEAR.

One in three older adults falls each year, giving rise to fatal and nonfatal injuries. Residents' falls within older care facilities are particularly expensive medical situations. Being out in nature sustains personal mobility, leading to reduced falls and reduced need for medications. Further, those who are socially isolated are more likely to be unhealthy, so gardening and nature walking activities that promote social interactions support positive lifestyles and quality of life.

HYPERTENSION

$1.3-$2.4B SAVINGS ON TREATMENT COSTS ANNUALLY.

Hypertension, or high blood pressure, is one of the five most expensive conditions impacting older adults. Views of nature, particularly forests, and 'forest bathing' (casual walks in naturalistic forest settings) decrease diastolic rates.

COGNITIVE DISORDERS

$1.2-$2.3B ANNUAL SAVINGS ON MEDICAL SERVICES, NOT COUNTING THE VALUE OF HOME CAREGIVERS' SERVICES.

About one in five older adults experiences mental and cognitive disorders, with age being the greatest risk factor. In 2010, about 11% of people aged 65 or older were afflicted with Alzheimer's disease. Those with dementia have three times as many hospital stays per year as other elders. Encounters with nature improve symptoms related to cognitive disorders, such as agitation, depression, and reduced mobility.

contributing analysts:
Dr. Stephen Grado & Marcus Measells, MSU; Dr. Alicia Robbins, Weyerhaueser

Valuation Sources

Benefit x Nature x Health Outcome

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

common values: avoided costs & burden of illness

Summary Table

Millions of U.S. Dollars (2012)

Benefit (geographic scope)	Minimum ($)	Maximum ($)
Newborn Health (U.S.)	5.3	5.3
Attention Deficit Hyperactivity Disorder (U.S.)	383.5	1,917.7
Schools (U.S.)	20.4	1,262.9
Crime (U.S.)	340.6	899.4
Cardiovascular Disease (U.K., U.S.)	1,220.0	1,220.0
Alzheimer's Disease (U.S.)	724.6	1,449.2
Totals	**2,694.4**	**6,754.5**

Wolf, K.L., M.K. Measells, S.C. Grado, A.S.T. Robbins. 2015. Economic values of metro nature health benefits: A life course approach. Urban Forestry and Urban Greening.

Avoided Costs Potential?

ELSEVIER

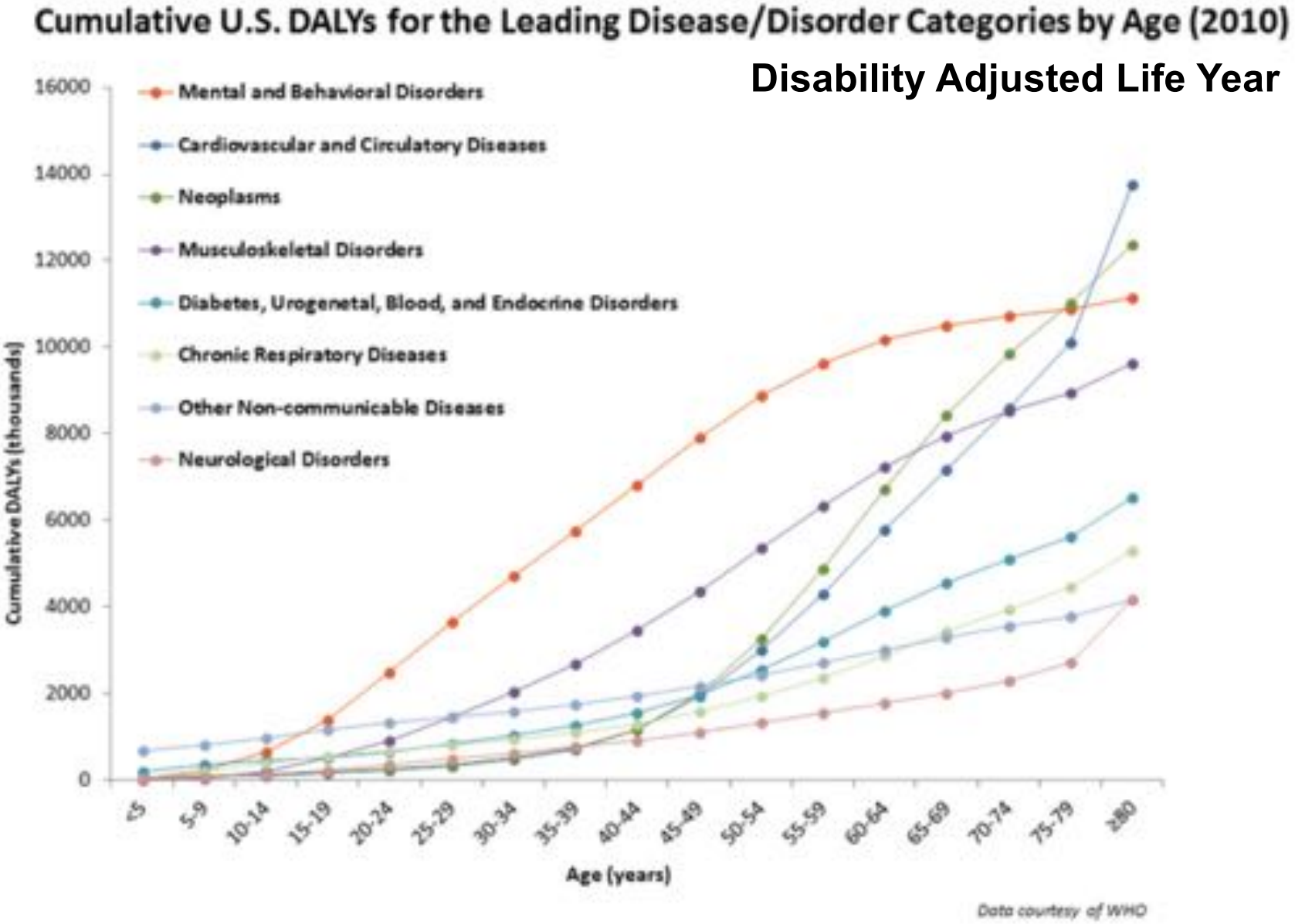
Urban Forestry & Urban Greening

Volume 41, May 2019, Pages 39-47

Is green land cover associated with less health care spending? Promising findings from county-level Medicare spending in the continental United States

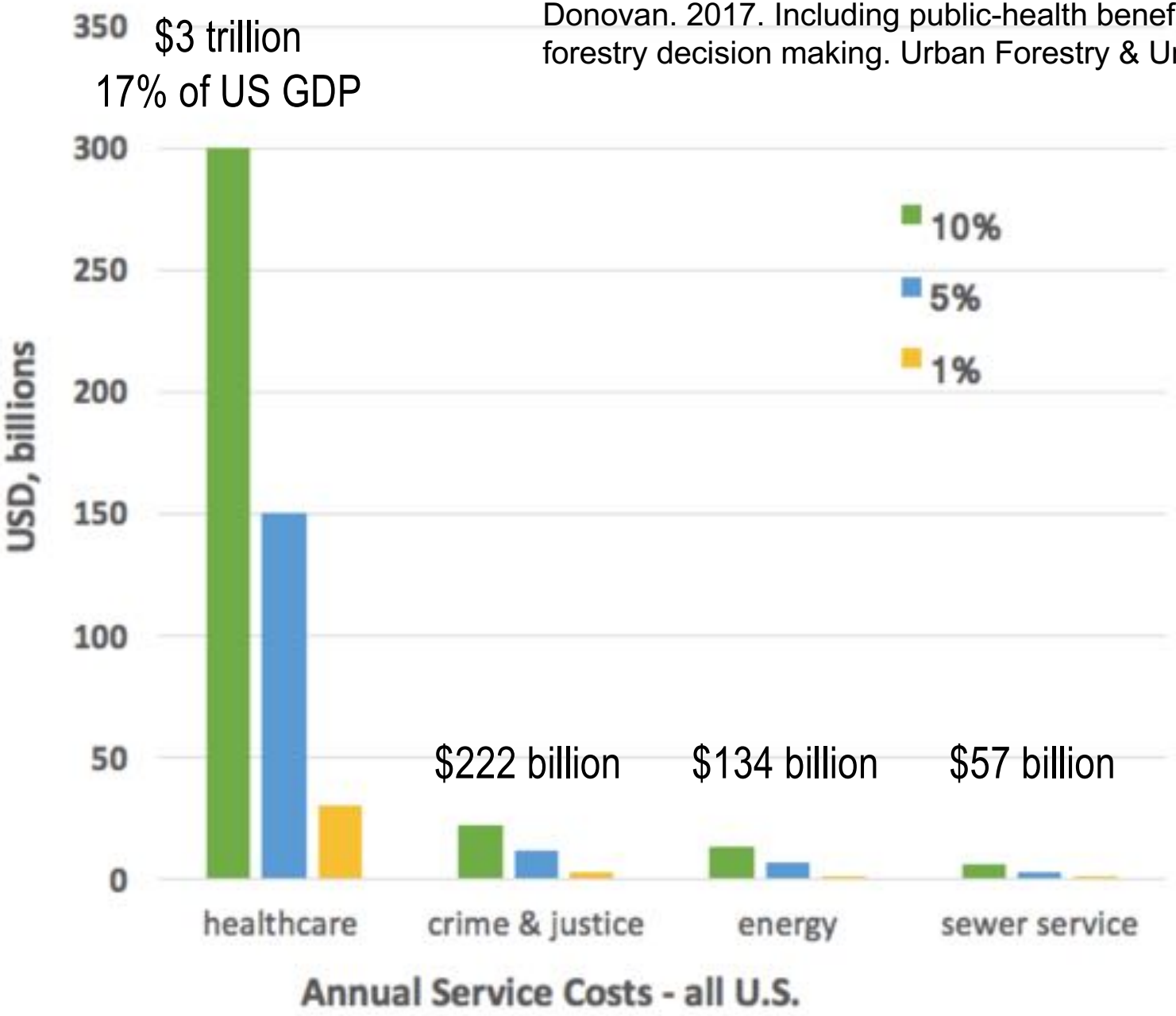
Douglas A. Becker [a], Matthew H.E.M. Browning [a, b], Ming Kuo [a], Stephen K. Van Den Eeden [c]

Lifecycle :: disease & illness



Avoided Costs Potential?

Donovan. 2017. Including public-health benefits of trees in urban forestry decision making. Urban Forestry & Urban Greening



Urban Forests for Human Health: A Focused Economic Valuation

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with a donation to the TREE Fund

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TREE Fund · 552 S. Washington St., Ste. 109, Naperville, IL 60540

Summary

1. History :: Environmental Health :: Sanitary to Sustainable Cities

3. Evidence = Shift (policy)

2. Nature as Social Determinant of Health

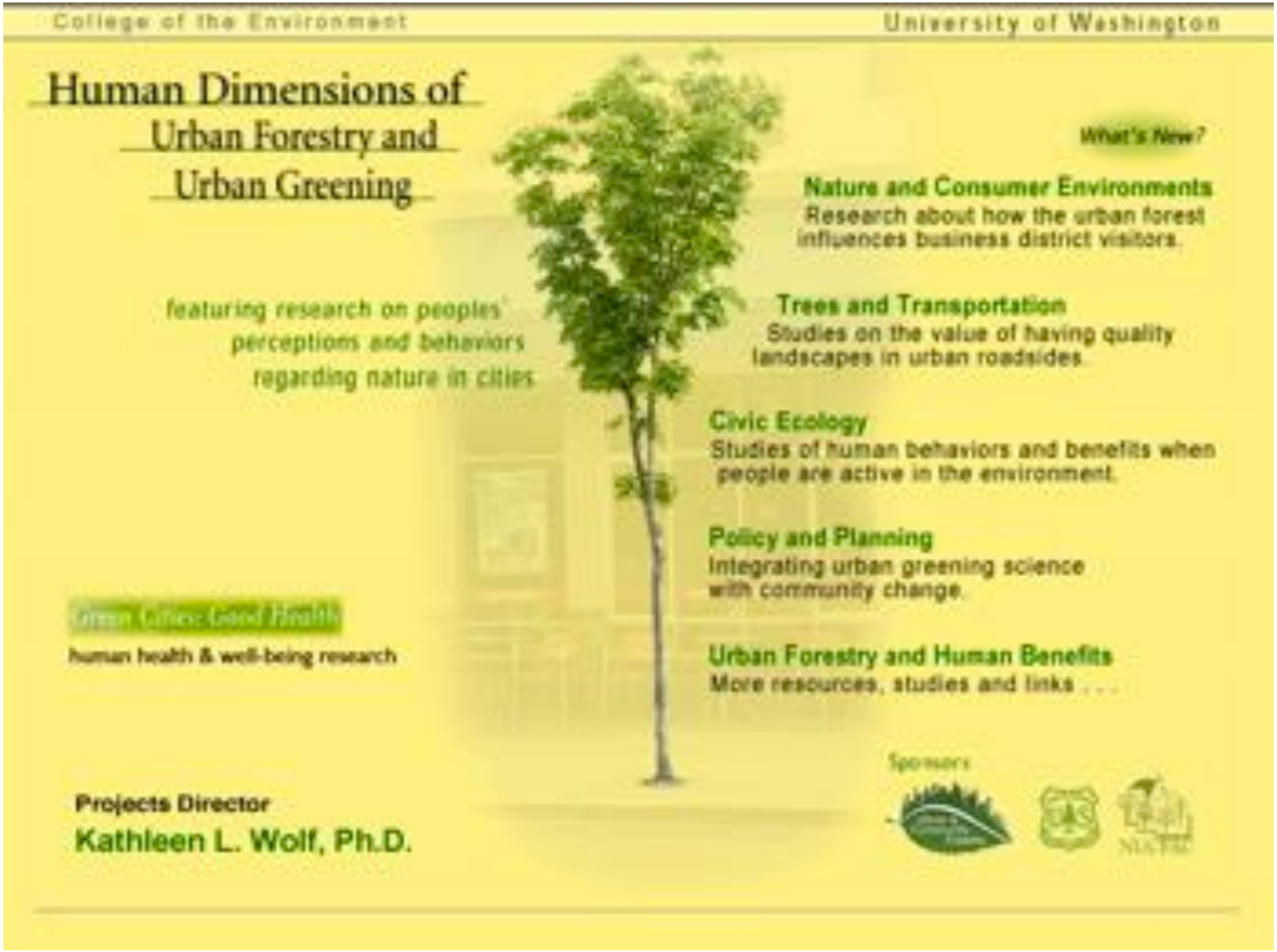
Seven Sisters Oak, Mandeville :: Chuck Cook, The Times-Picayune

So the tree rustles in the evening . . .

Trees have long thoughts,
long-breathing and restful,

just as they have longer lives than ours.

Hermann Hesse, *Trees: Reflections and Poems*

NEXT

www.naturewithin.info