Fine-Scale Environmental Indicators of Well-Being for Urban Communities

Part of the ACES 2016 Session: “Evidence-Based Approaches for Linking Ecosystem Services and Human Health”

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EnviroAtlas: [www.epa.gov/enviroatlas](www.epa.gov/enviroatlas)

An online decision support tool for viewing, analysing, and downloading geospatial data related to **ecosystem services**

- Maps, data, tools and information about the supply, demand, drivers, and social benefits of ecosystem services
- National & community components
- Population and climate scenarios
- Reference data (e.g., boundaries, land cover, soils, impaired water bodies, wetlands, demographics)
- Analytic and interpretive tools
- Free & open access

Developed through cooperative effort among multiple Federal agencies, universities, and other organizations
Ecosystem Services & Health: Unrealized Assets = Unintended Consequences

Approach: Demonstrate Multiple Benefits of Green Infrastructure,

• Clean air
• Clean & plentiful water
• Natural hazard mitigation
• Climate stabilization
• Recreation, culture & aesthetics
• Food, fiber & materials
• Biodiversity conservation

...and How They Relate to Human Health & Well-Being

➢ Air and water pollutants removed by neighborhood tree cover
➢ Homes and schools near busy roadways
➢ Extreme heat events
➢ Opportunities for physical exercise, social engagement, outdoor experience, and play
➢ Distributions of vulnerable populations

Boiling it down: Hazard Buffering and Health Promotion
Literature Review: The Eco-Health Relationship Browser

4 ecosystems:
- Forests
- Urban Ecosystems
- Wetlands
- Agro-Ecosystems

6 Ecosystem Services:

Health promotional services
- Aesthetics & Engagement with Nature
- Recreation & Physical Activity

Buffering services
- Clean Air
- Clean Water
- Heat Hazard Mitigation
- Water Hazard Mitigation

30+ health outcomes:
- Asthma
- ADHD
- Cancers
- Cardiovascular diseases
- Heat stroke
- Healing
- Low birth weight
- Obesity
- Social relations
- Stress
  ... many more

Incl. extensive bibliography (n ~ 300)
Disparate Methods; Unknown Transferability of Research Findings

“Children who lived in greener neighborhoods were less likely to increase their BMI z-scores over two years compared to those who had less-green neighborhoods (Bell et al. 2008).”

“The odds of hyperactivity/inattention problems were almost 1.5 times higher for children living 500 meters from urban green spaces than those living within 500 meters (Markevych et al. 2014).”

“The probability of five-year survival of senior citizens increased from 66% when participants had very few parks and tree-lined streets near the residence, to 74% when there were plenty of both (Takano et al. 2002).”

“...more cases of worsening asthma in flooded households (48%) than in non-flooded (25%) (Reacher et al. 2004).”

“Greenspace buffers between 100 m and 500 m were associated with birthweights that increased at least 15 g for each interquartile range increase in average greenness (Dadvand et al. 2014).”

“With strategic tree placement, annual reductions in ambient concentrations of PM 10 may reach 7-20% (Bealey et al. 2006).”

“A 10 micro-g/m3 rise in PM10 was estimated to represent a 5.8% increase in daily bronchitis hospital admissions (Wordley et al. 1997).”

Causality and Mechanisms Are Often Also Unclear
Examples of Community Health and Well-Being Indicators to Assist Decision-Making
e.g., health interventions, public infrastructure, social equity

- Opportunities for physical activity, engagement with nature, & social interaction
- Potential to improve school performance through cognitive restoration & stress reduction
- Modeled hazard mitigation: heat, air pollutants, contaminated runoff

Consistent metrics available across all EnviroAtlas communities

Pictured: Greater Durham, NC
HIA: Should County Permit Local Businesses/Orgs. to Offer Exercise Classes in Public Parks? Access to Green Space & Nature

“Of the 28,086 estimated population for the target area, approximately 19.1% of people live within 500 meters walking distance from a target park entrance.”
Jackson Heights, Queens – 1101 acres
Flatbush, Brooklyn – 1039 acres
Lower East Side, Manhattan – 536 acres

Jackson Heights is 17% tree canopy and 24% green space
Flatbush is 23% tree canopy and 28% green space
Lower East Side is 27% tree canopy and 34% green space

For every acre in Jackson Heights, there are 98 residents
1 box = 5 people, full rectangle = 1 acre
For every acre in Flatbush, there are 100 residents
1 box = 5 people, full rectangle = 1 acre
For every acre in Lower East Side, there are 126 residents
1 box = 5 people, full rectangle = 1 acre

Summer temp reduction
0.70 °F
Runoff avoided (per acre)
1395 gallons
Respiratory health savings (per 10,000 residents)
$1421
Schools with adequate green space (% of total)
50%
Green streets (% of total acreage)
1.4%
Community gardens
0

Summer temp reduction
0.82 °F
Runoff avoided (per acre)
1623 gallons
Respiratory health savings (per 10,000 residents)
$3305
Schools with adequate green space (% of total)
33%
Green streets (% of total acreage)
1.2%
Community gardens
1

Summer temp reduction
1.01 °F
Runoff avoided (per acre)
1558 gallons
Respiratory health savings (per 10,000 residents)
$4071
Schools with adequate green space (% of total)
79%
Green streets (% of total acreage)
4.9%
Community gardens
29
Multiple Moving-Window Metrics w/1m Landcover Data for Geospatial Matching to Confidential Health Data

Memphis, TN
(50m tree cover)

Tampa/St. Petersburg, FL (250m, 1,000m green space)
Birth weight

For a 10% increase in green space...

Birth weight (g)

Analysis Buffer
50 100 250 500

N = 22,893 (2004-2009)
Bush et al. unpublished

Depression

All regression models controlled for race/ethnicity, age, education and smoker status, plus selected other covariates (e.g., BMI, housing density).

N = 204; (2013)
Egorov et al., in prep.
Fine-Scale Green-Space Pattern Metrics: Indicators of Walkability

Quantifying tree cover in estimated sidewalk area

Quantifying total green space in pedestrian viewshed

Leah Yngve, former ASPPH fellow with EnviroAtlas
% sidewalk tree cover by city block

Intersection density w/in 750m

(Google Maps Street Views)
Street-Level Green Space vs. Physical Activity

Survey respondents in Milwaukee and Green Bay, WI
N = 712 (2008-2013)

Significant joint effects:
In neighborhoods with >15% sidewalk tree cover AND high intersection density (>25/km²), OR = 2.07 (95% CI: 1.04-4.12).

In neighborhoods with >15% sidewalk tree cover AND perceived proximity to a store, OR = 3.51 (95% CI: 1.64-7.51).

*** adjusted for education, race/ethnicity, age, season, city, intersection density, walking distance to nearest park entrance, and economic hardship index

** adjusted for job status, residential status, city, and economic hardship index (EHI)
* adjusted for above, plus intersection density and perceived proximity to a store
In New Bedford, MA, and Portland, ME, a 10% increase in alternative transportation is associated with ~15-20% decrease in green space, respectively (not shown; Yngve et al., in prep.).
Additional Health Issues Under Analysis or Planned

- Body mass index
- Children’s blood lead levels
- Autism rates
- Rates of ADHD-related behavior
- Unexplained sudden death
- Life expectancy
Questions?

Thank You!

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