

A person with their arms raised in a field of tall grass under a bright sky. The person is seen from behind, wearing a dark top, with their arms extended upwards. The background is a soft-focus landscape with green grass and a bright, hazy sky. The overall mood is one of freedom and connection with nature.

Nature and Human Health: Opportunities to Enhance Health and Ecosystem Conservation

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Conservancy &**

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Nature/Biodiversity and Human Health

- New evidence suggests important connections between biodiversity and human health and well-being

Biodiversity
WE ARE ALL IN THIS TOGETHER



Human Health and Well-Being

- “...a state of physical, mental and social well-being and not merely the absence of disease or infirmity.”
-World Health Organization (1946)



Questions



1. Is there convincing evidence that experiencing more natural settings can improve psychological and physical health?
2. Does exposure to biodiverse nature result in measurable health responses?
3. Can biodiversity provide humans and animals protection from allergic and inflammatory diseases?
4. Does biodiversity play a role in decreasing disease transmission?

(Sandifer, Sutton-Grier and Ward, 2015)

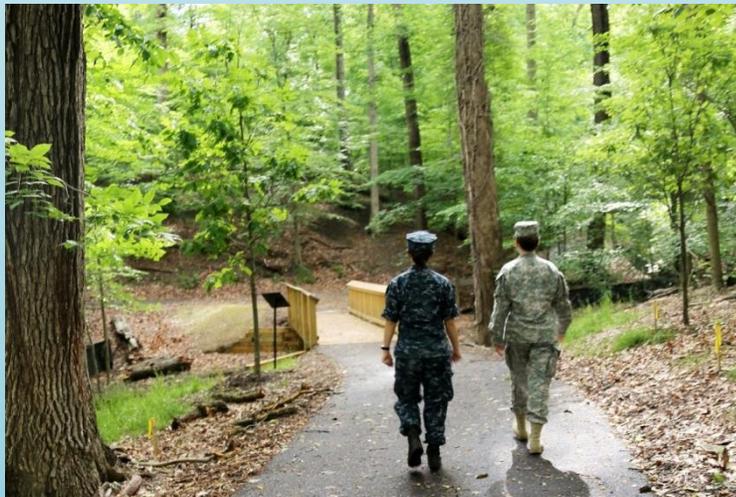
Results: Nature and Human Health



Reduces stress, blood pressure



Improves mood, self-esteem, energy, pleasure



Improves recovery from surgery, trauma



Decreases prevalence of asthma, anxiety

Biodiversity and Human Health

Growing evidence that contact with diverse natural habitats has important positive impacts for human health



Greater decrease in heart rate and more improvement in mood with fish diversity Cracknell 2015



Reflection, sense of identity, and sense of place increased with plant and bird diversity
Fuller et al 2007



Preference for outdoor activity in biodiverse environments Dallimer 2012

Chronic Diseases and Biodiversity



- Allergy: response to exposure to too much bad stuff
 - Allergy: *lack* of exposure to microbes → hyper-responsiveness to bioparticles
 - Microbe-rich environments confer health benefits especially to children
 - “Biodiversity” or “Hygiene” hypothesis
 - Loss of macrodiversity → loss of microdiversity → changes in human microbiota and results in variety of disorders
- (Hanski et al. 2012, Rook 2010, Strachan 1989)

Biodiversity or Hygiene Hypothesis

Exposures during human evolution	Situation in modern urban centre
Helminths Gut and non-gut (blood)	LOST
Ectoparasites Fleas, lice, mites, ticks	MOSTLY LOST
Carrier states Salmonella, hepatitis A virus, <i>H. pylori</i> , TB, toxoplasma	MOSTLY LOST
Microbiota of other humans: skin, gut, airway, oropharyngeal, genitourinary	DIMINISHED diversity
Microbiota of natural environment: animals, soil, air, plants (rhizosphere, phyllosphere)	VARIABLE loss

- Our bodies must learn not to attack:
 - Self
 - Harmless molecules in air (pollen)
 - Gut contents

(Rook 2013)

Finland Adolescent Study

- Analyzed land-use types within 3km radius of homes
 - Kids with allergies
 - Lower diversity of habitats
 - Fewer kinds of positive bacteria on their skin
- (Hanski et al. 2012)
- **Loss of contact with diverse natural world is making us sick**



Conservation Magazine

Disease Transmission and Biodiversity?

- Species and habitat diversity can impact transmission of diseases:
 - 1) by altering the abundance of the host or vector
 - 2) changing the behavior of the host, vector, or parasite
 - 3) influencing the condition of the host or vector(Keesing et al. 2010)



African Savannah Large Herbivore Exclosure Experiment

- Loss of diversity of large herbivores leads to more fleas and an elevated risk of transmission of *Bartonella* spp (bartonellosis)
- Mechanism? → decrease in competition or change in vegetation structure



Young et al. 2014



“Extinction of Experience”: Less Daily Contact with Nature



Two Components to This:

- Loss of opportunities to experience nature in urban environments
- Loss of orientation meaning reduced emotional affinity for nature

Extinction of Experience: Children

United Kingdom

United States



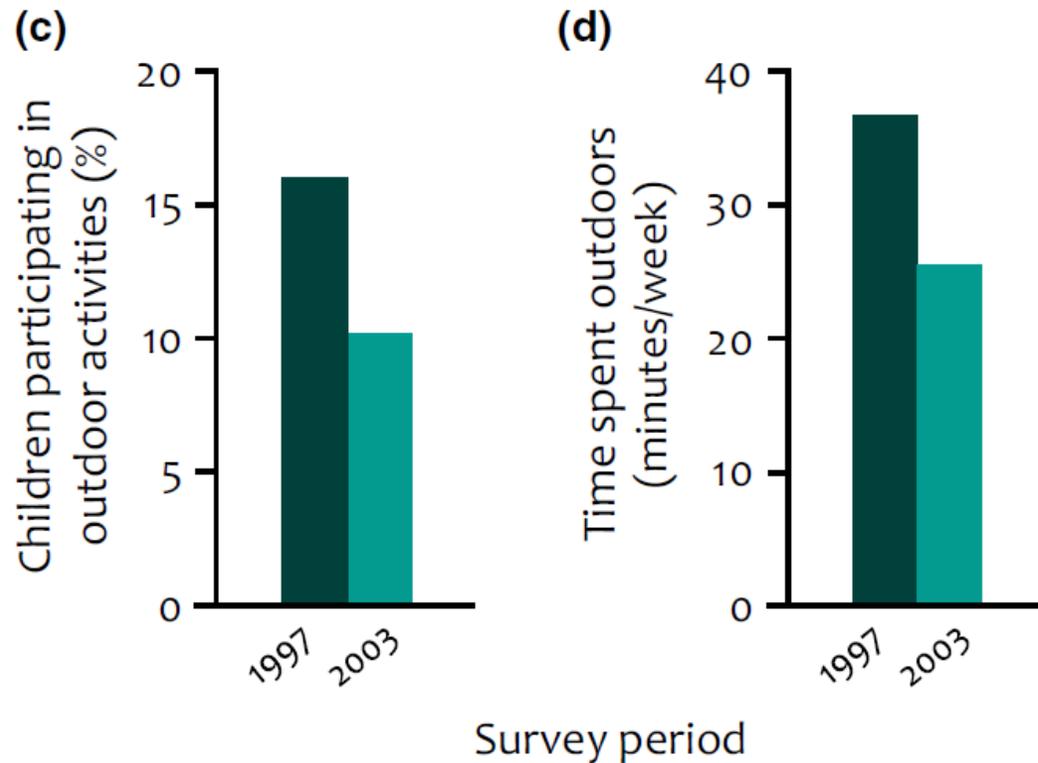
Soga and Gaston. 2017. *Frontiers in Ecology and the Environment*

Extinction of Experience: Children

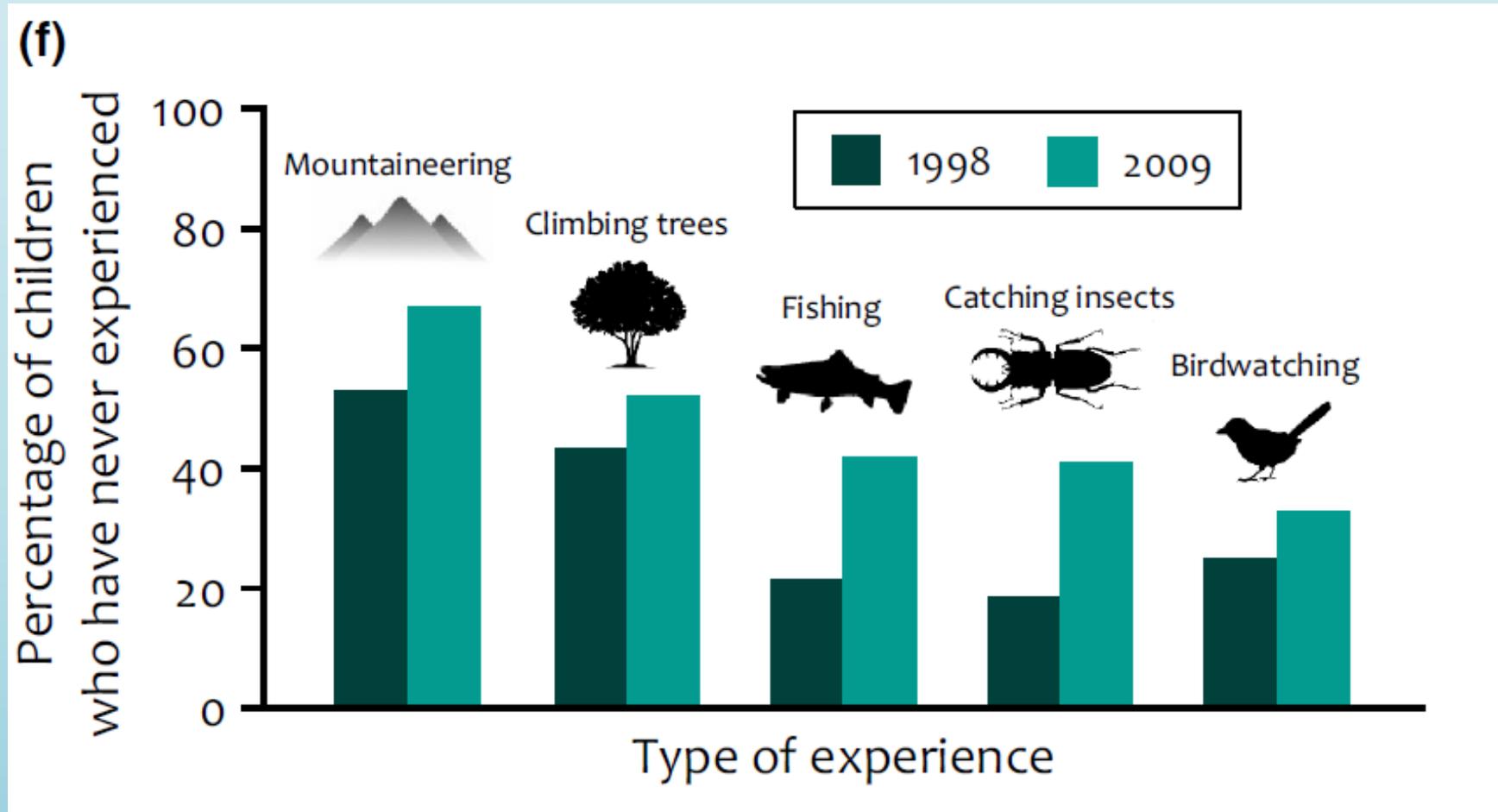
United States

Japan

Frequency of visit to natural areas

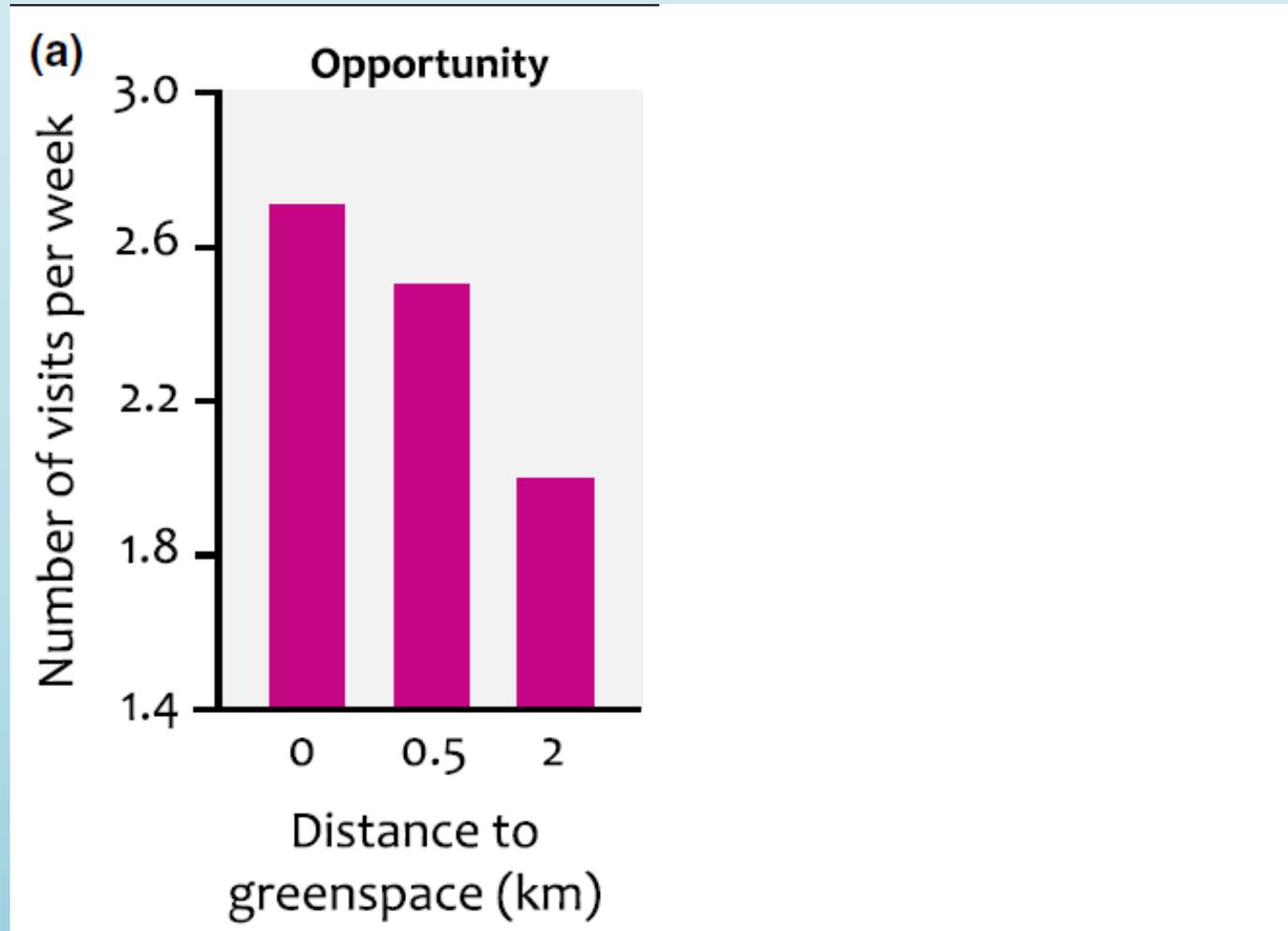


Extinction of Experience



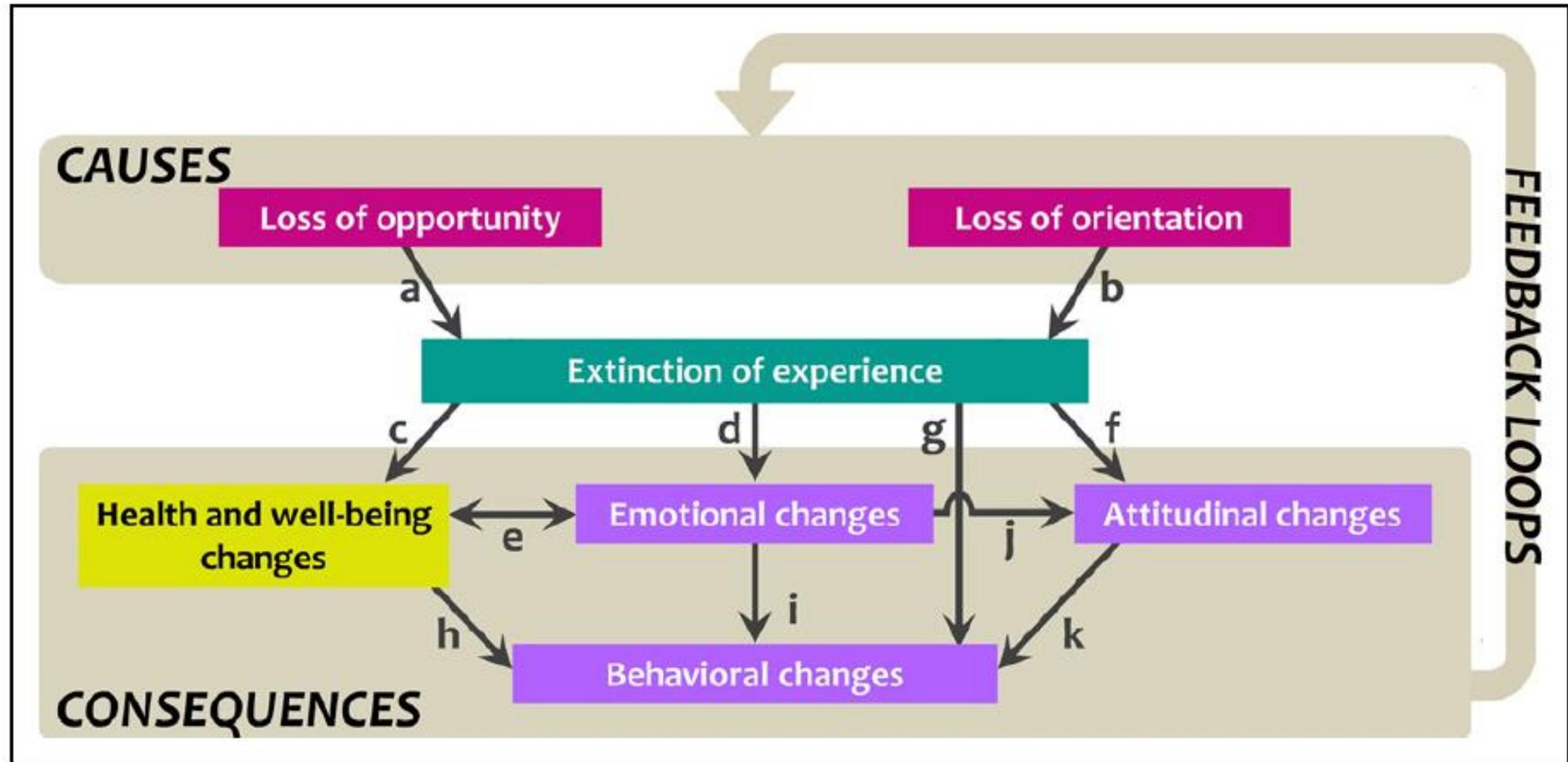
Soga and Gaston. 2017. *Frontiers in Ecology and the Environment*

Causes of the Loss of Interaction with Nature

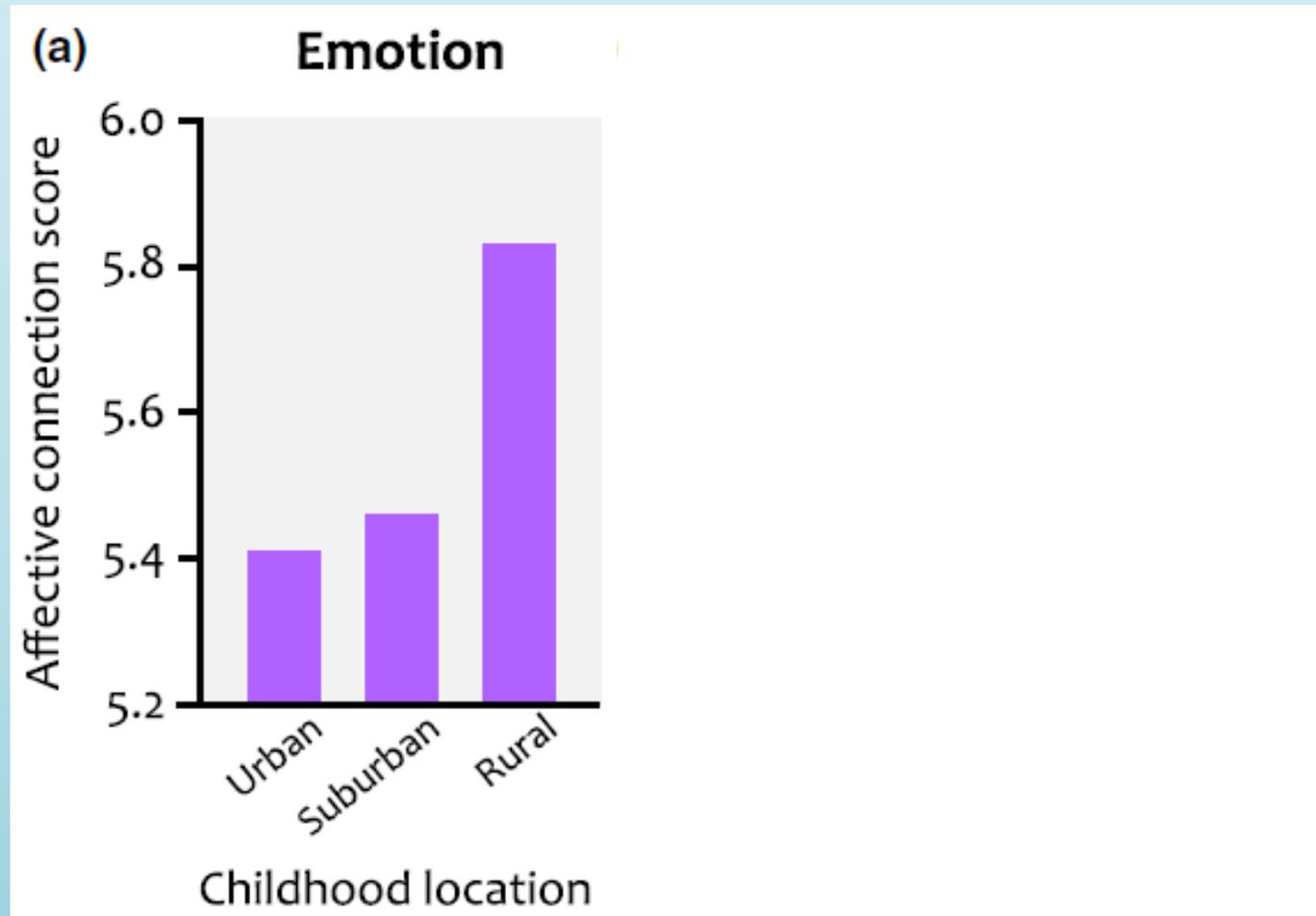


From *Neuvonen et al. 2007 and Lin et al. 2014* in Soga and Gaston. 2017

Feedback Loop

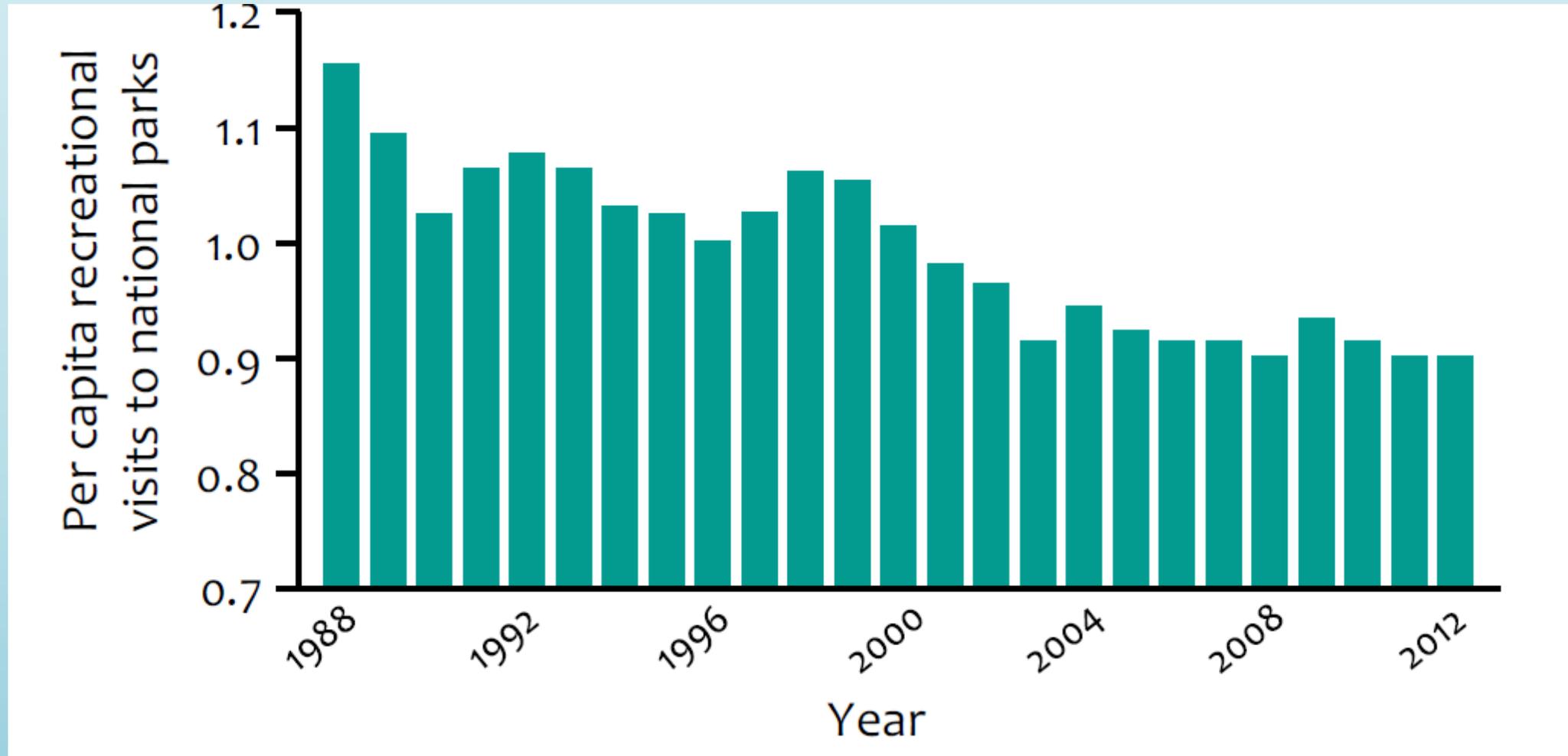


Nature Exposure: Connection and Behavior



Hinds and Sparks 2008 and Wells and Lekies 2006 in Soga and Gaston 2017

Extinction of Experience: U.S. National Parks



What is the “Right” Dose of Nature?

- How do you measure the quantity and quality of the environment experienced?
 - Number of environments/habitats experienced?
 - Number of species? Percent cover of vegetation?
 - Density of trees? “Greenness”?
- How do we quantify human health exposure?
 - Frequency and pattern of exposure
 - Duration of exposure (mins in a park? Years lived in a neighborhood?)
 - What health aspect you care about → restoration vs disease prevention



Examples of Patterns of Response to Nature

- Shanahan et al. 2015.
BioScience
 - Dose thresholds for
vegetation cover at
which mental health
issue lowered
 - >20% for depression
 - >30% for anxiety
 - >20% for stress
- (Cox et al. 2017 BioScience)

What is the Value of Nature in Cities?

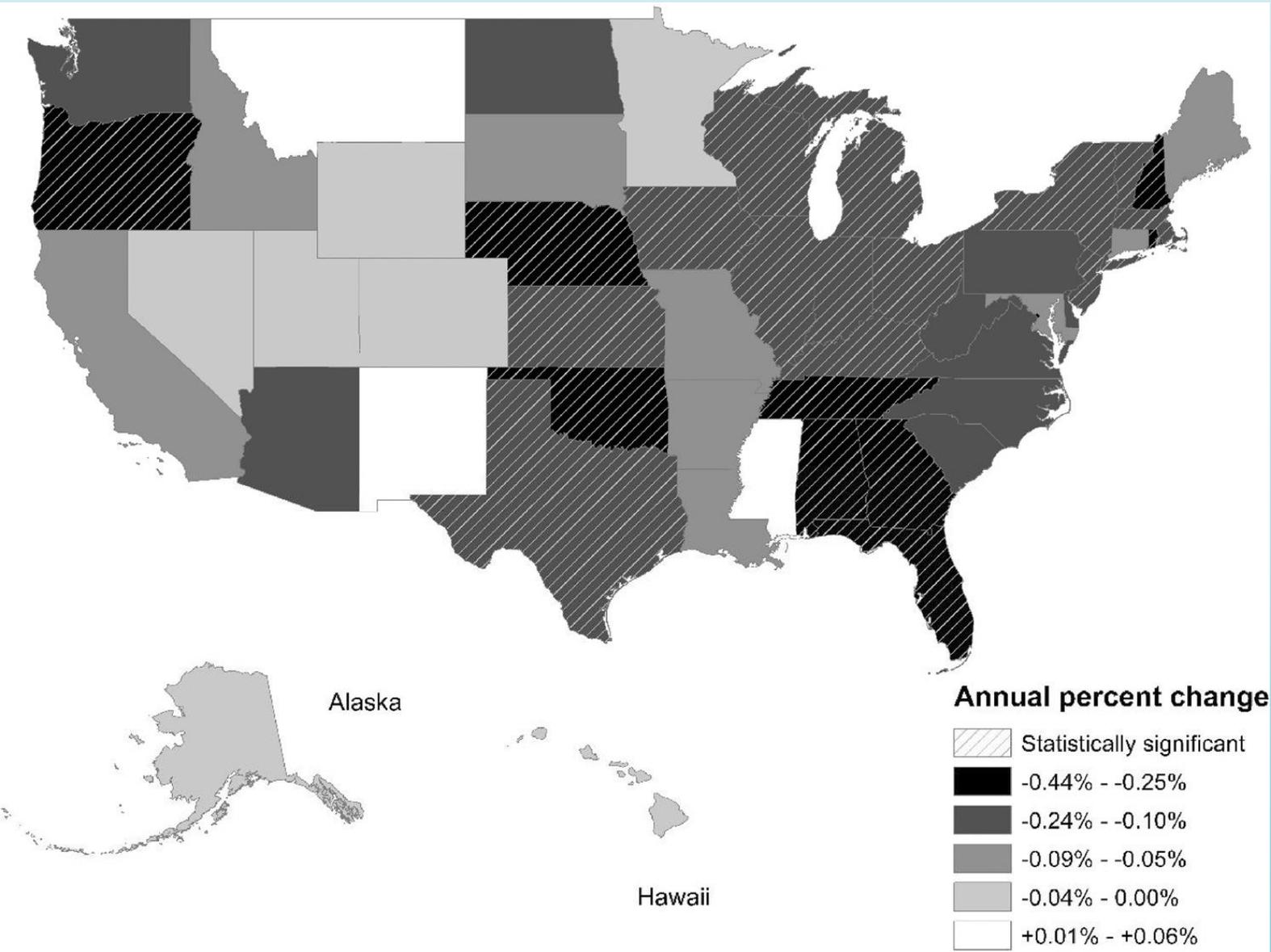
- 10 million trees in Toronto (Toronto 2013 Strategic Forest Management Plan)
 - Worth \$7 billion
 - Stores 1.1 million metric tons of carbon
- Higher tree density in Toronto → people report higher health perception and fewer cardio-metabolic problems
- 10 more trees per block → improves health perception comparable to getting \$10K more per year
- 11 more trees per block → decreases cardiometabolic conditions in ways comparable to an increase in income of \$20K or being 1.4 years younger (Kardan et al. 2015 Nature Scientific Reports)



What is one tree worth?



Tree Loss in U.S. Urban Areas



- 2009-2014
- 36 million trees per year lost
- Benefits lost worth ~\$96 million per year
- D.C. and Oregon two of largest places with loss

(Nowak and Greenfield, 2018)

Ongoing Research Needs

- Specific mechanisms for biodiversity affects human health
- Best ways to measure biodiversity to determine human exposure?
- Which metrics of health would be the best indicators of biodiversity-human health impacts?
- Better monitor biodiversity and integrate info into public health and natural resource management and policy
- Need for large, community-wide health datasets and over longer periods of time

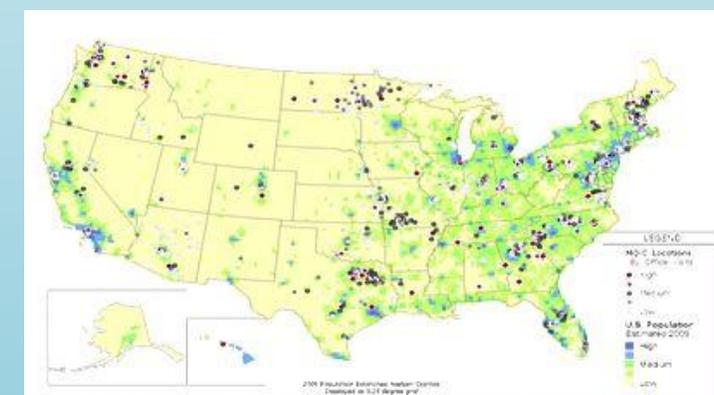
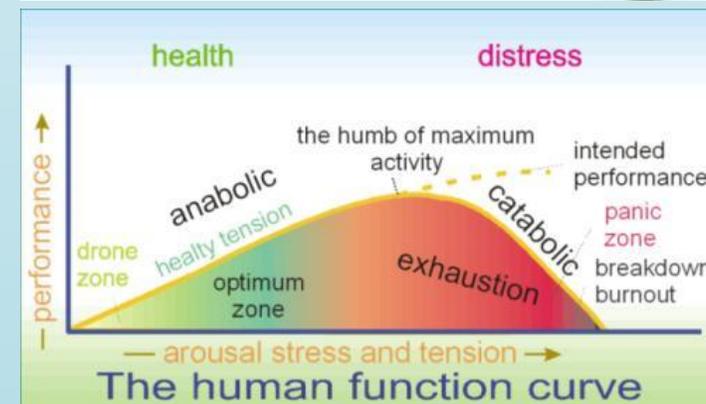
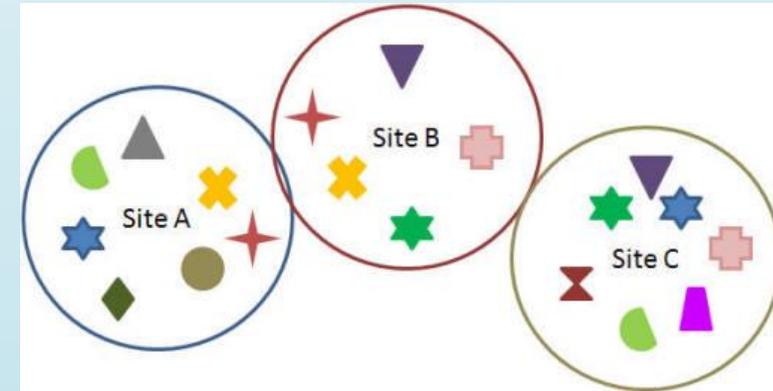


Figure 2. The Medical Quality Improvement Consortium (MQIC) comprises 35 million de-identified patient records from participating CPS and Centricity EMR practices.

Nature/Biodiversity Conclusions

- Exposure to nature has direct, positive health effects and exposure to biodiversity may have direct, positive impacts human health
- Potential to implement these findings to enhance human well-being *and* develop increased public support for green & blue space protection and restoration



What Can We Do to Increase Human Exposure to Nature?



1. Incorporate More Natural Ecosystems into Urban Landscape Planning, Resilience Efforts, and Disaster Planning



Invest in More Green Space and Parks in Urban Areas: Rouge National Urban Park!



Thanujan24 - Own work, CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=60334295>



Find Other Ways to Incorporate Nature: Stormwater Green Infrastructure Projects



Use “Natural Infrastructure” in our Coastal Resilience Efforts



Use “Hybrid” Approaches that Include Natural Elements



PERMEABLE PAVING

Gravel paving absorbs storm water

BIOSWALES

Filters 60-90% of suspended solids and prevents water from overflowing sewer systems

BIORETENTION

Filters 80-90% of suspended solids and slows flow of storm water into sewer systems

WETLAND CREATION

Native ecological habitat and storm water infiltration



REBUILD BY DESIGN MEADOWLANDS

AECOM

Hybrid Infrastructure: Living Shorelines

- Living shorelines: Use a combination of habitat restoration and built features to provide protection from erosion and storms
- Provides many of the benefits of natural habitats
- Restored marsh with oyster sill, Pivers Island, NC



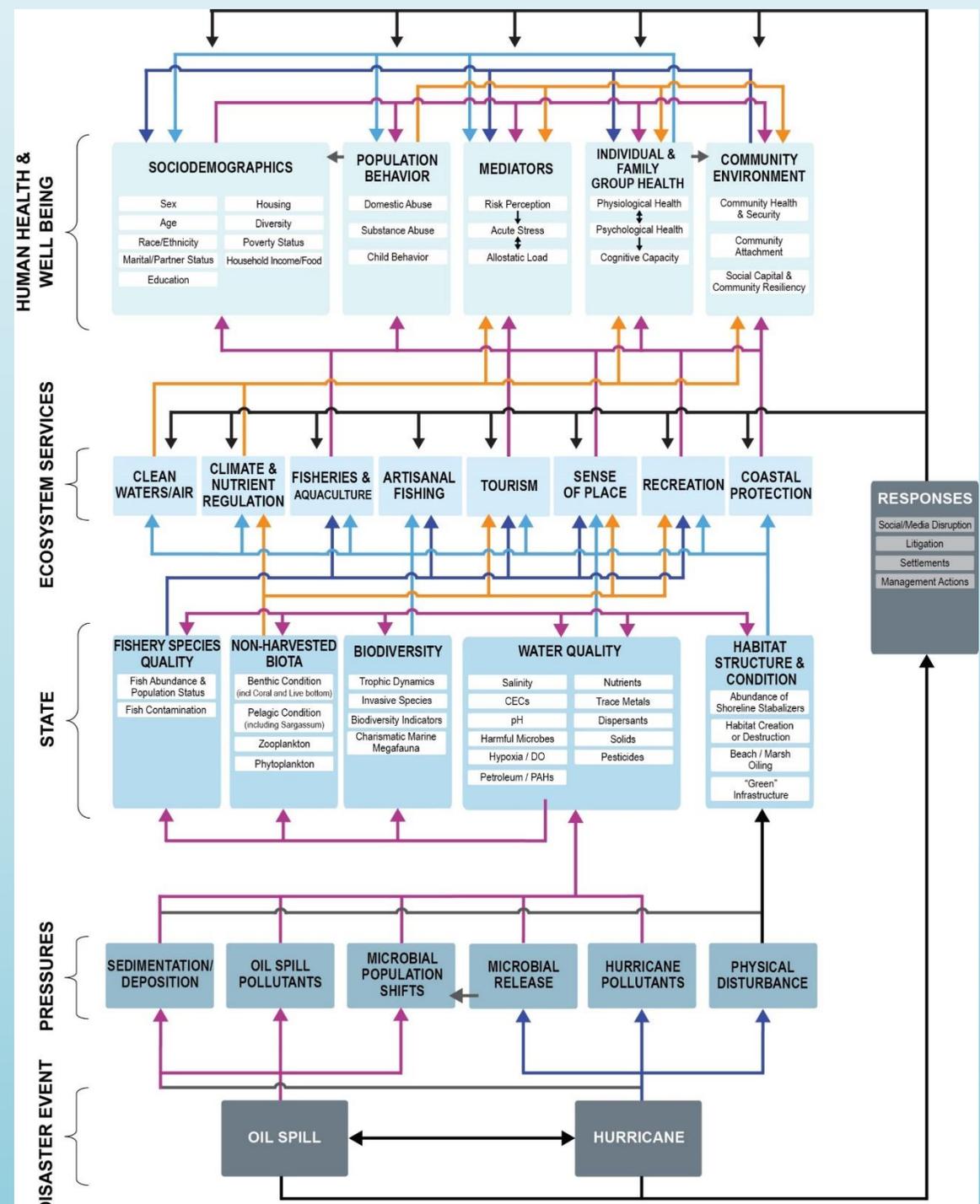
Before



After

Incorporate Natural and Hybrid Solutions into Disaster Risk Planning Efforts

Modeling stress-associated health effects of multiple impacted ecosystem services in the Gulf of Mexico (Sandifer et al. 2017)



Better Disaster Relief Planning?

- Include ecosystems for their storm and erosion risk reduction benefits (natural and hybrid infrastructure)
- AND can we mitigate the stress of disasters by strategically using green and blue space exposure?
- “Blue health”, promoting healthy coastal and ocean ecosystems and human health via exposure to those ecosystems



2. Spread the Word! Nature Exposure for Immune Function and Health and for Developing Affinity for Nature and Pro-environment Behaviors



Help kids get outside to be exposed to nature



Mitigate Extinction of Experience with Nature Based Citizen Science



Schuttler et al., 2018.
Frontiers in Ecology and
the Environment

ParkRx Platform



Find Parks

What is Park Rx America?

Leaderboard

Resources

Media

Contact

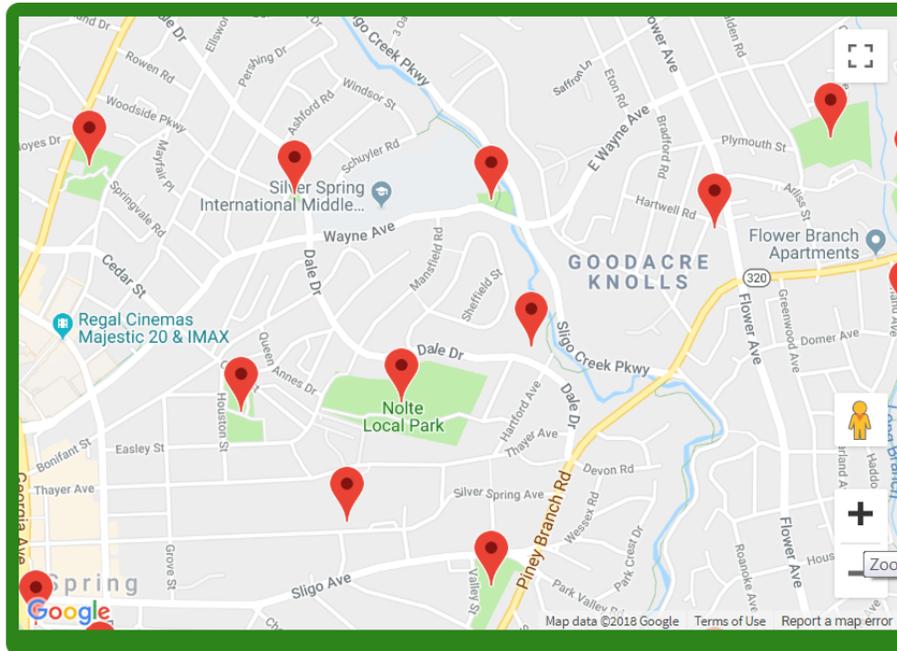
Silver Spring, MD 20910

Go >

WITHIN RADIUS: .25 MILE .5 MILE 1 MILE 2 MILES 3 MILES 5 MILES 10 MILES

104 results

FILTER RESULTS



SORT BY: Distance Park Name

- 0.5mi Woodside Urban Park
- 0.6mi Kramer Urban Park
- 0.6mi Montgomery Regional Office-MRO...
- 0.6mi Royce Hanson Urban Park
- 0.7mi Rosemary Hills-Lyttonsville Local ...
- 0.8mi Birch Drive Neighborhood Conser...
- 0.8mi Ellsworth Urban Park

CHECK TOP 5

VIEW SELECTED PARKS

powered by Park Rx America

Nolte Local Park

200 Denver Road, Silver Spring, MD 20910



OWNER: The Maryland-National Capital Park and Planning Commission
Website | Events
CONTACT: (301) 495-2595

GENERAL INFO:

Park Type: Neighborhood Park

Overall Size: Larger than a football field

Special Features/Comments: Fields require a Permit for Organized Play

GETTING THERE:



SPORTS:

Sports Facilities/Activities: Baseball/Softball Field, Football/Soccer Field, Outdoor Basketball Court

AMENITIES:

General Park Amenities: Drinking Fountains, Playground

NatureRx@Cornell



Home



About Us



How it works



Nearby Nature



Resources



Time in Nature = A Healthier You



Beebe Lake



Newman, Slim Jim Woods



Cascadilla Gorge



NatureRx at College of William and Mary

Have You Had Your Dose of Outside Today?



HOME

WHAT IS PARK RX?

PRESS

PARK AMBASSADORS

CALENDAR

GET FIT AND HAPPY

PARK SAFETY

FAQS

GET IN TOUCH

ACKNOWLEDGEMENTS



Coming Spring 2019: NatureRx@ University of
Maryland!

3. Develop Science to Understand the Mechanisms of Biodiversity-Human Health Relationship

Studying the impact of trees on cardiovascular health



THE GREEN HEART PROJECT

LOUISVILLE KENTUCKY

The Nature Conservancy  OUR WORLD

Breathe Easy Dallas, TX



Studying the impact of tree and shrub screening to capture pollutants on children's asthma

A photograph of a mangrove forest. The foreground is filled with a dense network of brown, woody mangrove roots and branches. Some branches have green leaves. In the background, a body of water with a vibrant turquoise color is visible. The sky is bright and overcast.

Got Nature?

Thank you!

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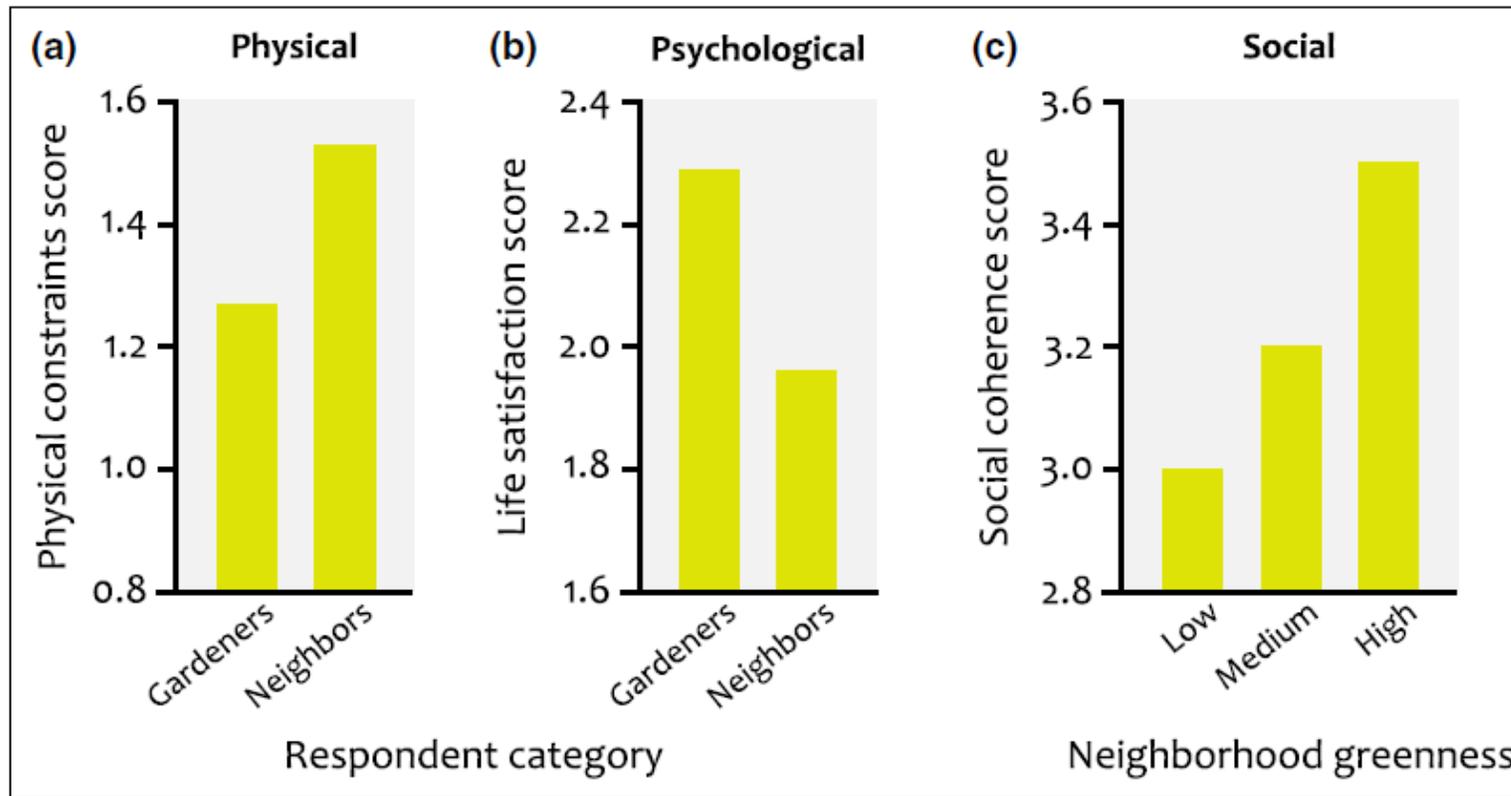
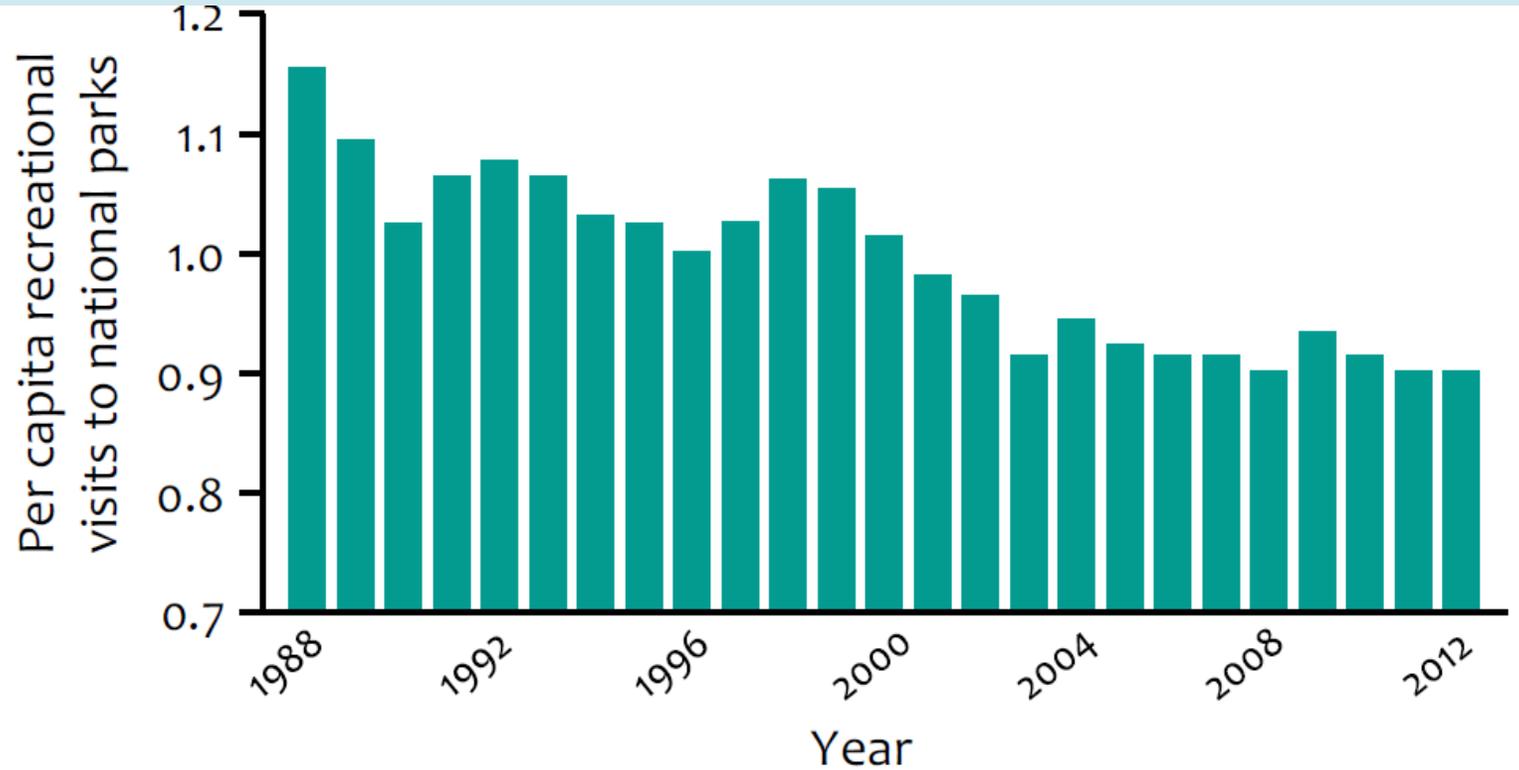
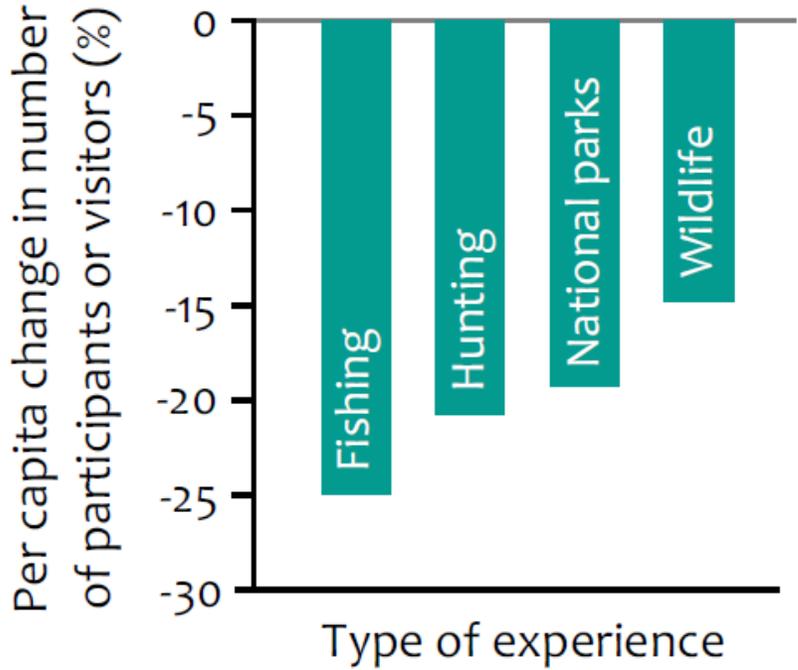


Figure 4. Changes in health and well-being due to loss of interactions with nature. (a) Physical health (physical constraints) and (b) psychological well-being (life satisfaction) reported in the Netherlands (van den Berg et al. 2010). (c) Social health (social coherence scores) reported in Australia (Sugiyama et al. 2008). Exposure to nature was measured by (a and b) participation in allotments (community gardening) and (c) levels of neighborhood greenspace. In panels (a) and (b), “neighbors” refers to the control group (ie those who did not participate in gardening).



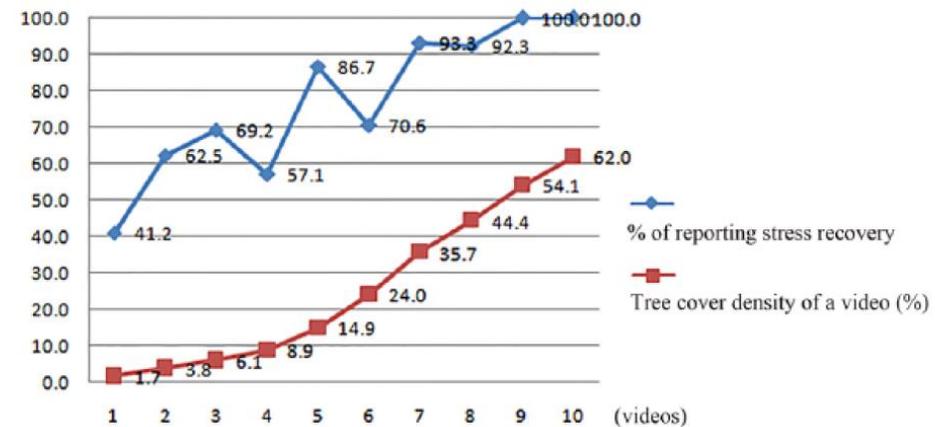
Extinction of Experience: National Parks



Canopy Cover and Stress Reduction

- More stress reduction when watching videos with neighborhoods with more trees (0-60%)

(Jiang et al. 2016)



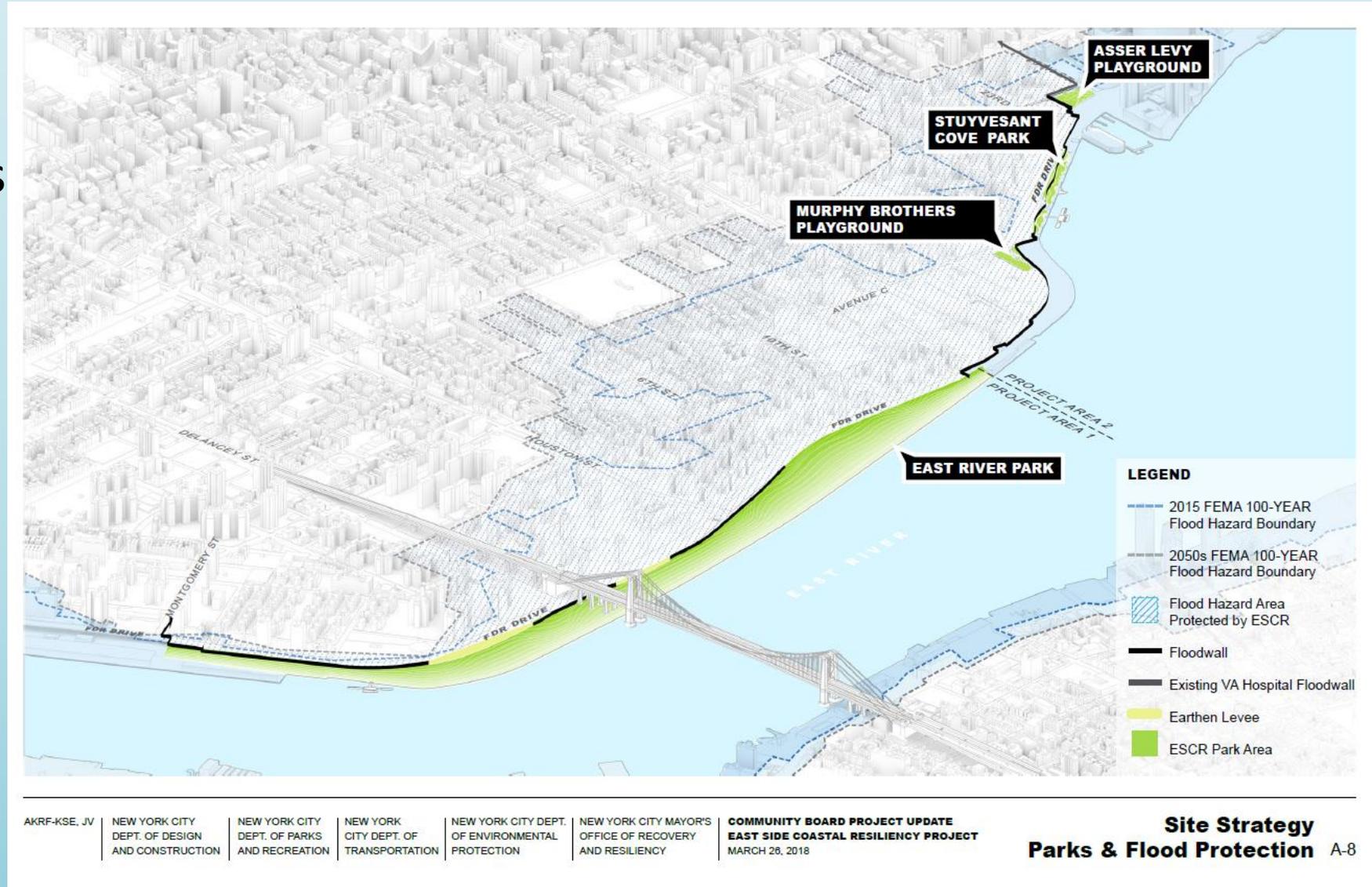
Our Nature, Our Health: Connections Between Protected Areas and Human Health





Rebuild By Design: “Big U” Project Provides Climate Adaptation and Recreational Opportunities

- Hard and soft infrastructure with recreational benefits
- Actual Implementation: East Side Coastal Resilience Project
- Integrate flood protection into community, improve water access
- Berms and flood walls or barriers



Rebuild By Design: “Big U” Project Provides Climate Adaptation and Recreational Opportunities



AKRF-KSE, JV

BJARKE
INGELS
GROUP

MATHEWS NIELSEN
LANDSCAPE
ARCHITECTS, P.C.

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AND CONSTRUCTION

NEW YORK CITY
DEPT. OF PARKS
AND RECREATION

NEW YORK
CITY DEPT. OF
TRANSPORTATION

NEW YORK CITY DEPT.
OF ENVIRONMENTAL
PROTECTION

NEW YORK CITY MAYOR'S
OFFICE OF RECOVERY
AND RESILIENCY

COMMUNITY BOARD PROJECT UPDATE
EAST SIDE COASTAL RESILIENCY PROJECT
MARCH 28, 2018

20th Street Park Entry
Preliminary Review - Closed B-21