Forest Bathing
Exploring the Spatial Relationship between Trees and Mental Health at a National Scale

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Mental Health:

- US: 20.9 million people/yr experience a mood disorder, 1 out of 20 currently depressed, depression costs $58 billion in economic burden
- Recognition of depressive disorders as *the* leading disability in middle and wealthy nations, and the need to explore new methods of treatment and alleviation

(CDC and US Dept. of Heath & Human Services; Atkinson & Weigand, 2008; Alcock et al. 2013; Elisabet et al., 2013)

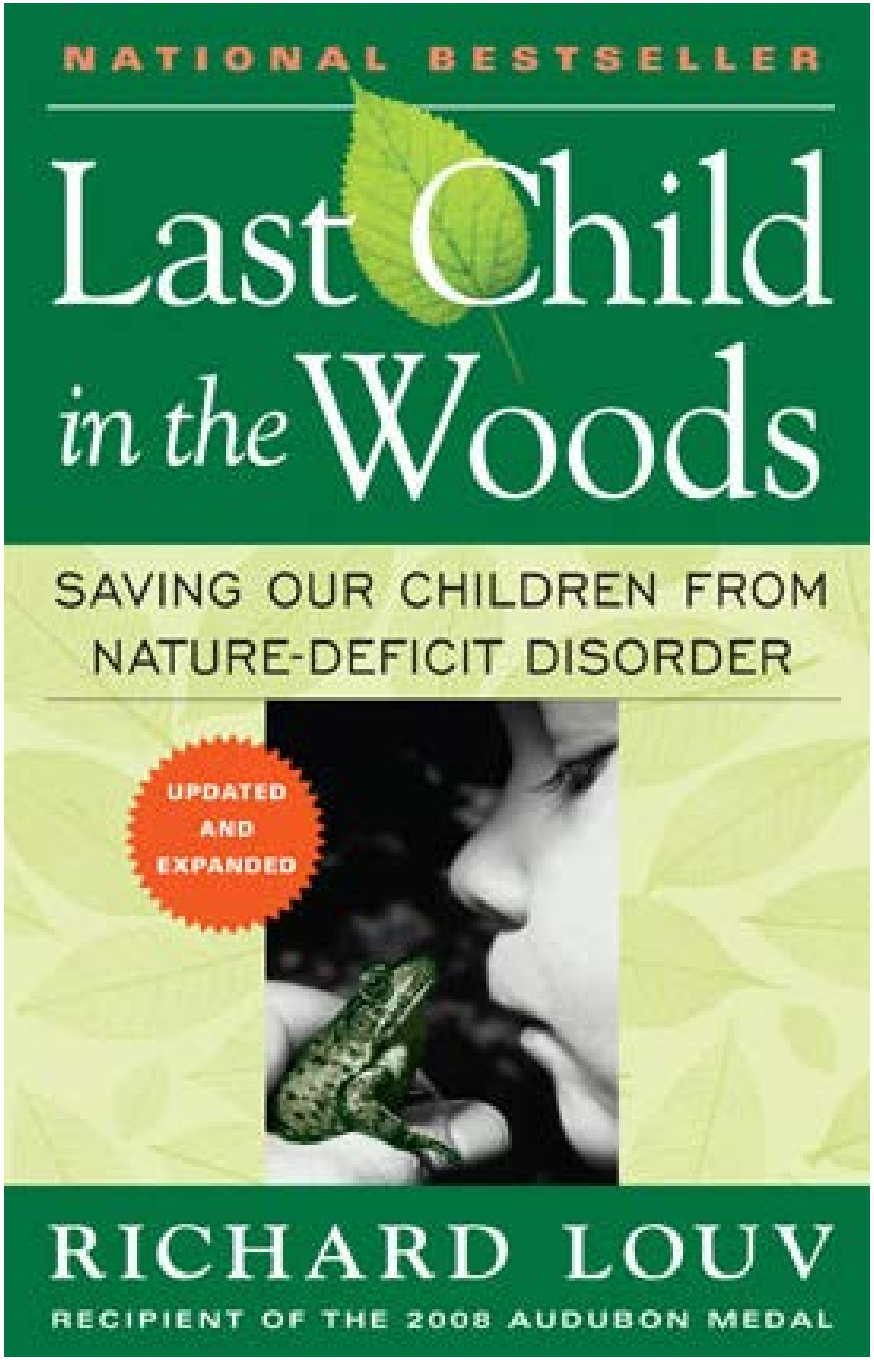
Changing Understanding of Mental Health

Stress Response Interpersonal Relationships Communication

Illness

Previously mental health was defined as a presence of mental deficit

(Pretty, 2004)



The Growing Field of "Forest Medicine"

Articles in Forest Medicine

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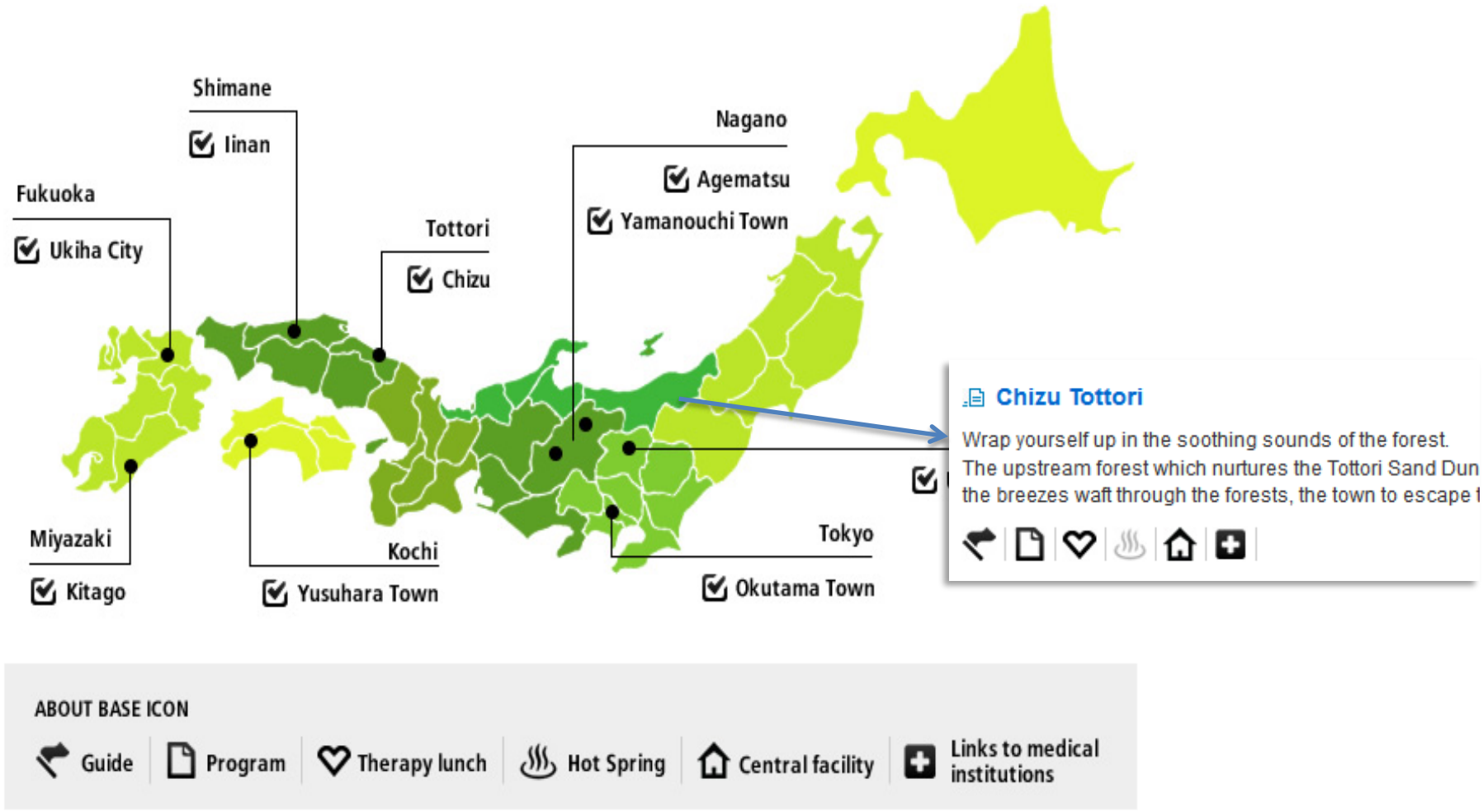
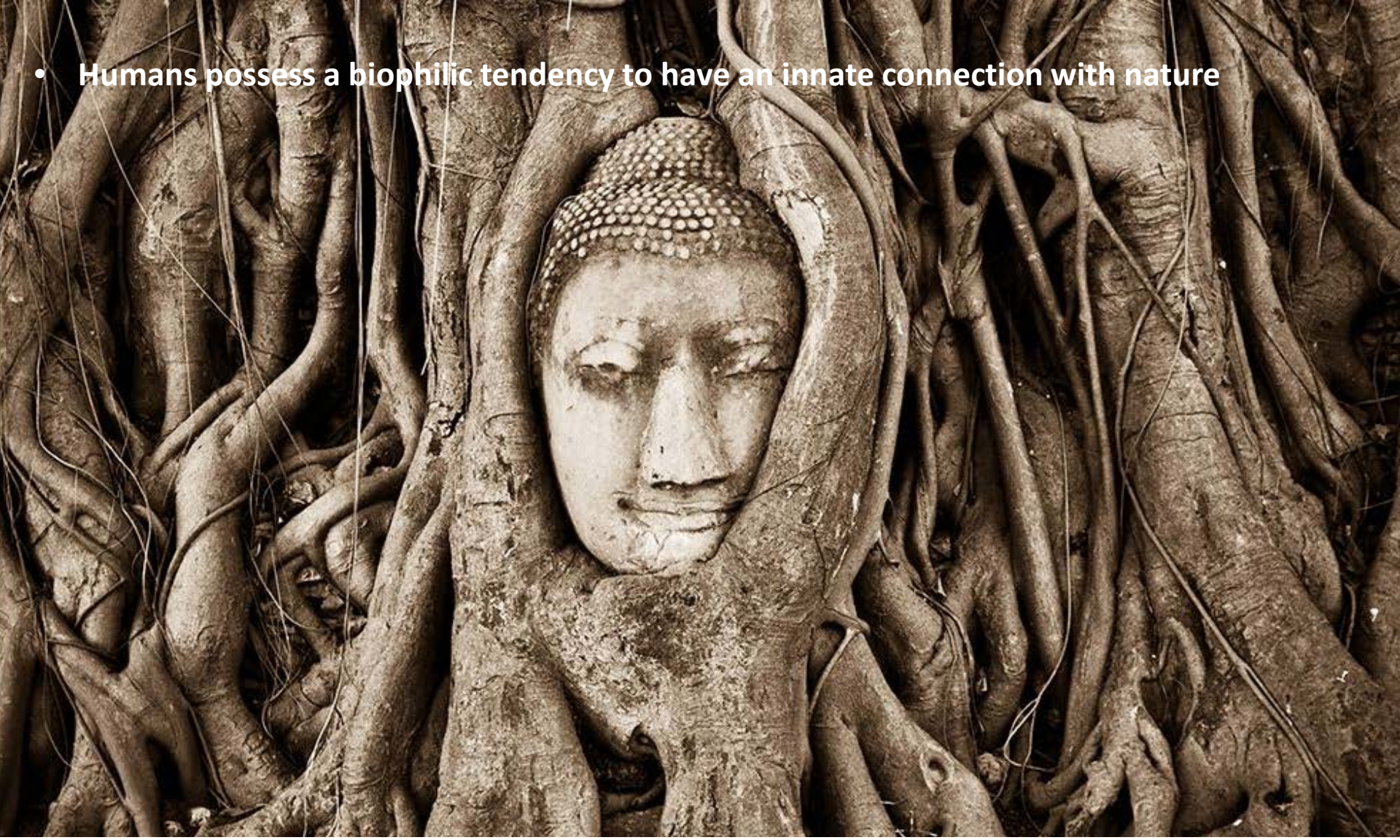
FOREST MEDICINE BASE IN JAPAN



- Increased physiological benefits
- Indirectly improve the overall cognitive and indirect functions of the psyche

	Author(s)	*Effect on mental well-being*
Forest Bathing	Morita et al., 2006	+
	Park et al., 2009	+
Biophilia	Gold, 1977	+
	Wilson, 1984	+
	Gullone, 2000	+
	Grinde and Patil, 2009	+
Defines Mental Health	Pretty, 2004	
Exhaustion Disorder	Elisabet et al., 2013	+
Built Environment	CDC, 2011	-
	Baskin, 1997	*
	Gullone, 2000	*
	Evans, 2003	-
	Peen, 2007	-
	Berman et al., 2012	+
	van den Berg et al., 2010	+
Tree Presence and Crime	Donovan and Prestemon	+
	Troy et al.,	+
"Green Exercise"	Barton and Pretty, 2010	+
	Groenewegen, 2006	+
Presence of "Green Qualities"	Weimann et al., 2015	+
	Alcock et al., 2013	*

(+) Indicate study demonstrates a positive relationship; (-) Indicate study demonstrates a negative relationship;
(*) Indicate study demonstrates both a positive and negative relationship



- **Humans possess a biophilic tendency to have an innate connection with nature**

Biophilia

(Ulrich 1993; Gold 1977; Wilson 1984; Gullone 2000; and Grinde and Patil 2009)

Gaps in our understanding:

- Are people happier because of proximity to nature?
- Or are happier people choosing to live near these spaces?

(Alock et al., 2013; Taylor et al. 2014)


Research Questions

- What is the nature of the relationship between mental health and tree abundance?
- Given many variations in tree abundance and mental health across the U.S., is there a statistically significant relationship between mental health and tree abundance identifiable at the national scale?


Data and Methods

National Survey on Drug Use and Health

% of persons 18 yrs or older that had in the last year experienced a:

(NSDUH 2010 3-year compilation)

Major depressive episode

Serious mental illness

Mental illness

Thoughts of suicide

Mental Health Data

- National Survey on Drug Use and Health (NSDUH) defined 67 substate regions for the "2008-2010 NSDUH Substate Estimates of Substance Use and Mental Disorders"

- These substate regions are geographic regions defined by counties and in some cases by census tracts from the 2000 census specified by a 6-digit tract identifier (NSDUH Substate Region Definitions 2014)

Mental Health Data

- NSDUH is an annual national survey that examines drug use and mental health of citizens from across the country.

- Approximately 70,000 individuals aged 12 or over are surveyed. Data was taken from the 2010 3-year compilation.

USDA FOREST SERVICE

Forest Inventory and Analysis National Program

Tree density per hectare
Total basal area
Average carbon storage

Tree cover
Average tree height

We are the Nation's Forest Census

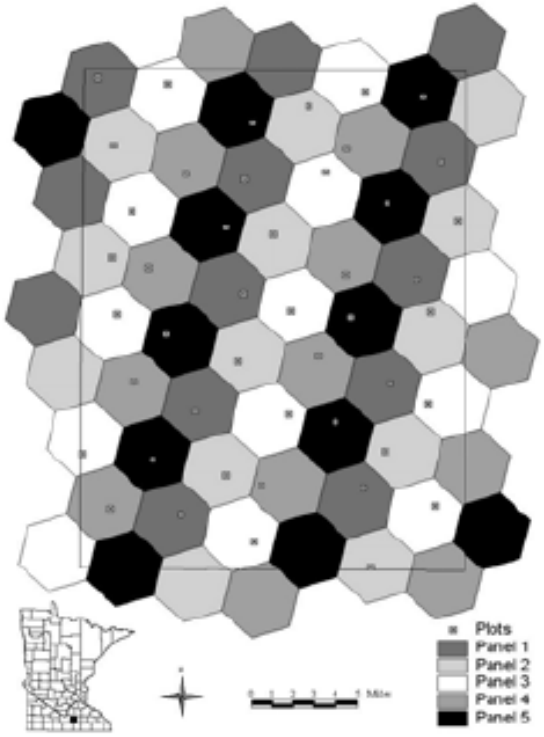
The Forest Inventory and Analysis (FIA) Program of the U.S. Forest Service provides the information needed to assess America's forests.

As the Nation's continuous forest census, our program projects how forests are likely to appear 10 to 50 years from now. This enables us to evaluate whether current forest management practices are sustainable in the long run and to assess whether current policies will allow the next generation to enjoy America's forests as we do today.

FIA reports on status and trends in forest area and location; in the species, size, and health of trees; in total tree growth, mortality, and removals by harvest; in wood production and utilization rates by various products; and in forest land ownership.

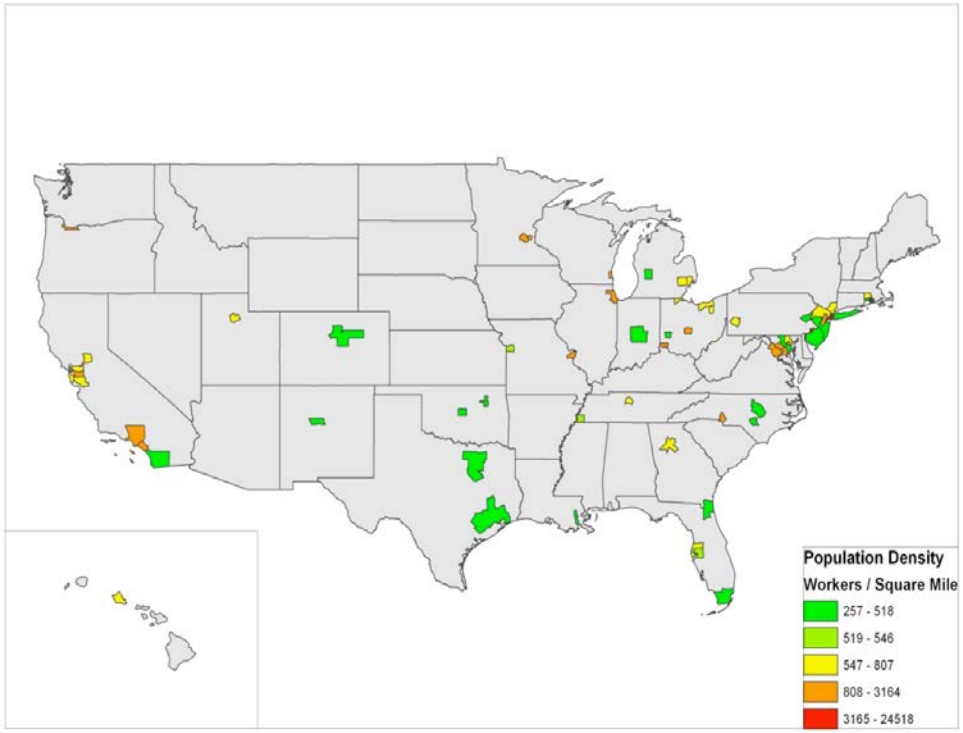
The Forest Service has significantly enhanced the FIA program by changing from a periodic survey to an annual survey, by increasing our capacity to analyze and publish data, and by expanding the scope of our data collection to include soil, under story vegetation, tree crown conditions, coarse woody debris, and lichen community composition on a subsample of our plots.

FIA is managed by the Research and Development organization within the USDA Forest Service in cooperation with State and Private Forestry and National Forest Systems. FIA traces it's origin back to the McSweeney - McNary Forest Research Act of 1928 (P.L. 70-466). This law initiated the first inventories starting in 1930.



GIS Analysis

- State and county FIPS code in the substate regions of the NSDUH was matched to the FIAA data
  - the FIAA contained data for 55/68 substate regions
- Calculated tree data was joined with the NSDUH data for the 55 substate regions



Statistical Analysis

- Linear regression used to model the relationship (while controlling for SES) between:

Dependent Variables	Independent Variables
major depressive episode	tree density
mental illness	tree basal area
serious mental illness	tree cover
thoughts of suicide	average tree height
	average above ground carbon storage

Log-log model used as variables were non-normally distributed.


Results

Descriptive Stats:

	Mean	*Min*	*Max (state)*
Tree Density/HA	129.23	19.6 (CA)	359.47 (CA)
Tree Basal Area	0.00243	0.0000034 (CA)	0.0191 (TX)
Tree Cover	0.001	0.000000114 (CO)	0.0103 (IN)
Average Tree Height	52.29	14.99 (NM)	93.8 (CA)
Tree Carbon Storage	408.48	51.28 9(NM)	2110.62 (CA)
Thoughts of Suicide	3.73%	2.76% (FL)	5.62% (UT)
Major Depression	6.44%	4.92 (FL)	9.01% (RI)
Mental Illness	19.79%	16.35%(FL)	24.57% (RI)
Severe Mental Illness	4.62%	3.49%(FL)	6.92% (RI)

Regression Models:

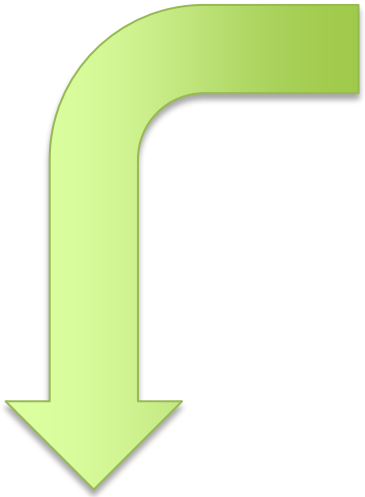
	Model 1 - ADJ Rsquared 0.203		
	B Coefficients	(SE)	p-Value
Carbon Storage	-0.046	0.021	0.034
Median Household Income	-0.08	0.065	0.22
Population Density	-0.047	0.018	0.01
	Major Depression		

	Model 2 - ADJ Rsquared 0.171		
	B Coefficients	(SE)	p-Value
Carbon Storage	-0.039	0.015	0.014
Median Household Income	-0.07	0.063	0.32
Population Density	-0.039	0.013	0.005
	Mental Illness		

	Model 3 - ADJ Rsquared 0.172		
	B Coefficients	(SE)	p-Value
Carbon Storage	-0.055	-0.027	0.05
Median Household Income	-0.06	0.061	0.27
Population Density	-0.077	0.024	0.002
	Severe Mental Illness		

Elasticities:

Change in Carbon Storage	Change in Major Depression
1%	-0.046%
10%	-0.46%
100%	-4.60%
Change in Carbon Storage	**Change in Mental Illness**
1%	-0.039%
10%	-0.39%
100%	-3.90%
Change in Carbon Storage	**Change in Severe Mental Illness**
1%	-0.055%
10%	-0.55%
100%	-5.50%



100% increase in average carbon storage → decrease of 5.5% in severe mental illness

(while holding all else constant)

Discussion and Conclusions

Mental illness is a complex issue… with multiple influences…

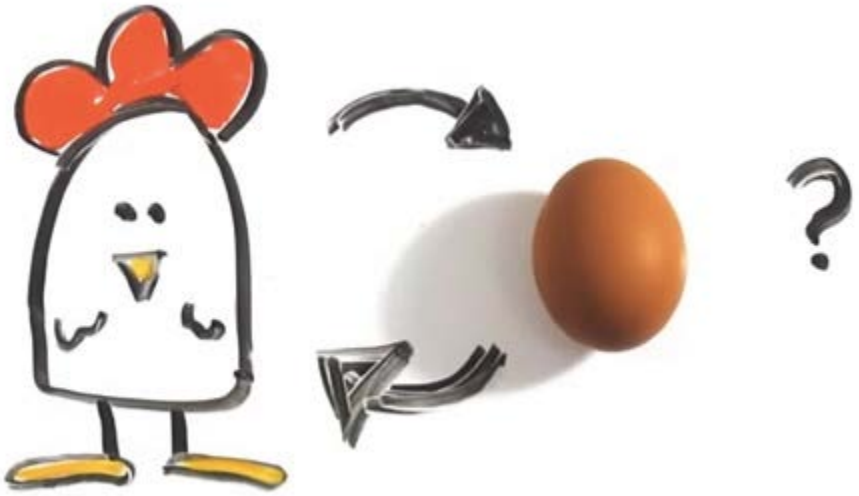
Biological

Environmental

Family Genetics

Psychological

Examining Self Selection Bias



Are healthier people choosing to live in areas with more access to nature?

Further Research Needed

- Expanding research to include more geographic areas
- Including regional dummy variables such as north, south, east and west to account for differences
- Including other variables such as access to nature and recreational activities outdoors

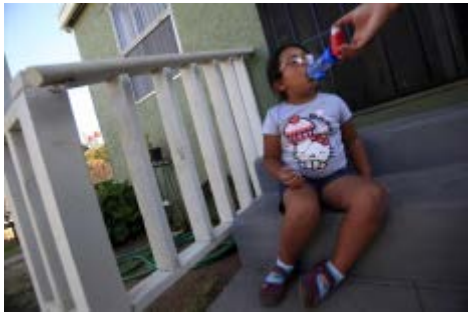
Need Qualitative Data

- Supplementing quantitative research with qualitative → survey people who live near nature about decisions of why they live in those locations

Further evidence that the built environment in its current form is bad for our health in multiple ways?

Mental Illness ?

Asthma



Obesity

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