CITY OF TAMPA – PLANNING & URBAN DESIGN HOSTS 'THE STATE OF THE URBAN FOREST'

MARCH 26, 2018
6:00 PM – 7:30 PM

Agenda

- Opening & Acknowledgements – Catherine Coyle
- Welcome & Introductions - Bob McDonaugh
- Urban Forest Management Plan Introduction And Background - Robert Northrop
- I-Tree Inventory and Analysis - Dr. Andrew Koeser
- Spatial Analysis - Dr. Shawn Landry
- Urban Forest Ecosystems Services - Dr. Andrew Koeser
- Economic Value To Residential Property - Dr. Shawn Landry
- Q & A

The State of Tampa's Urban Forest

Results from the 2016 Tree Canopy and Urban Forest Analysis

March 26, 2018

6:00 PM – 7:30 PM

Children's Board of Hillsborough County
1002 East Palm Avenue
Tampa, FL 33605

Dr. Shawn Landry
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Extension - Hillsborough Co.

Project Partners

- City of Tampa
  - Kathy Beck
  - Catherine Coyle
  - Eric Mueke
- University of Florida
  - Michael Andreu
  - Andrew Koeser
  - Rob Northrop
- University of South Florida
  - Shawn Landry
  - Ruiliang Pu
- University of Vermont
  - Jarlath O'Neil-Dunne
- US Forest Service
  - Geoffrey Donovan
- Numerous residents and stakeholders

State of Tampa's Urban Forest 2016

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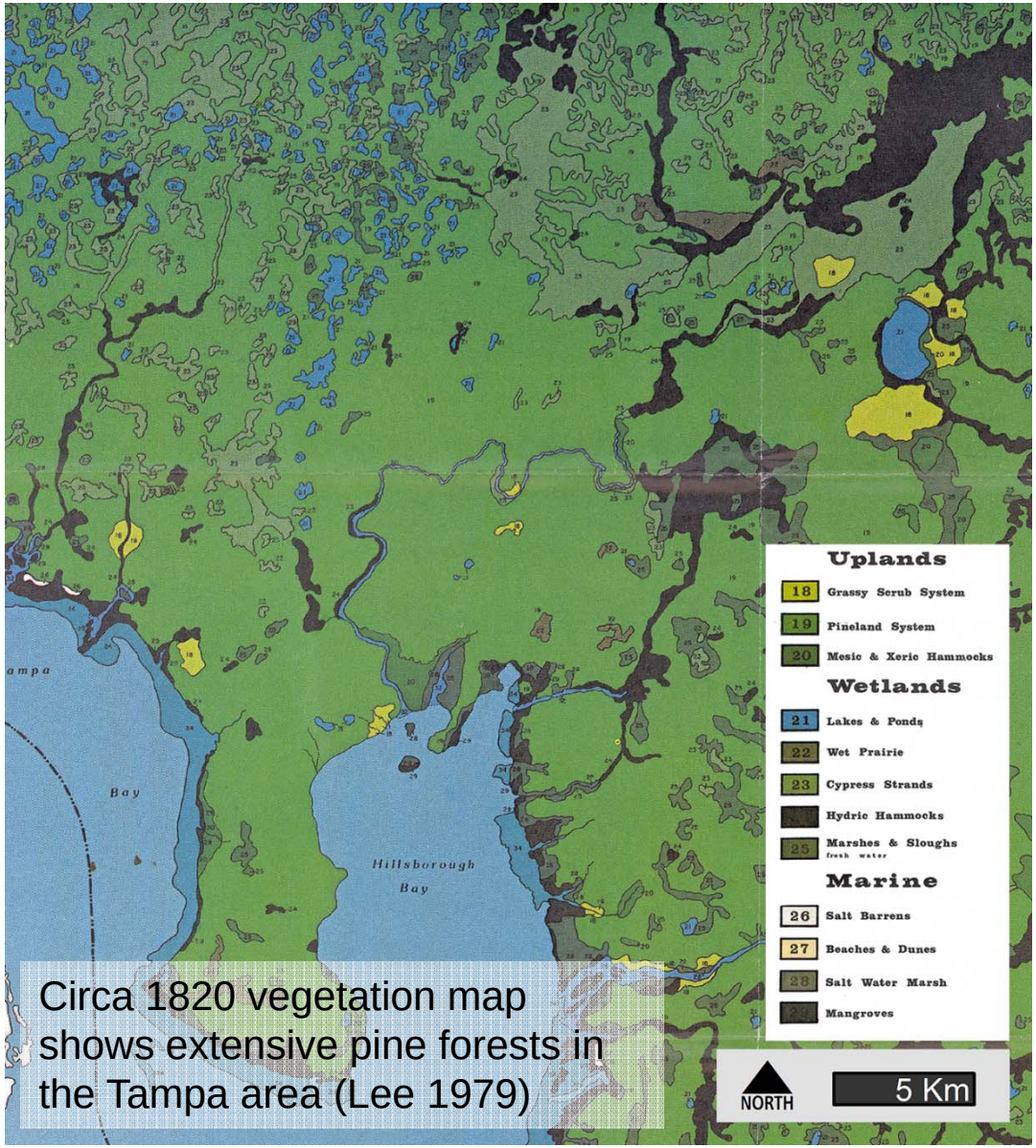
Background: A cultivated urban forest



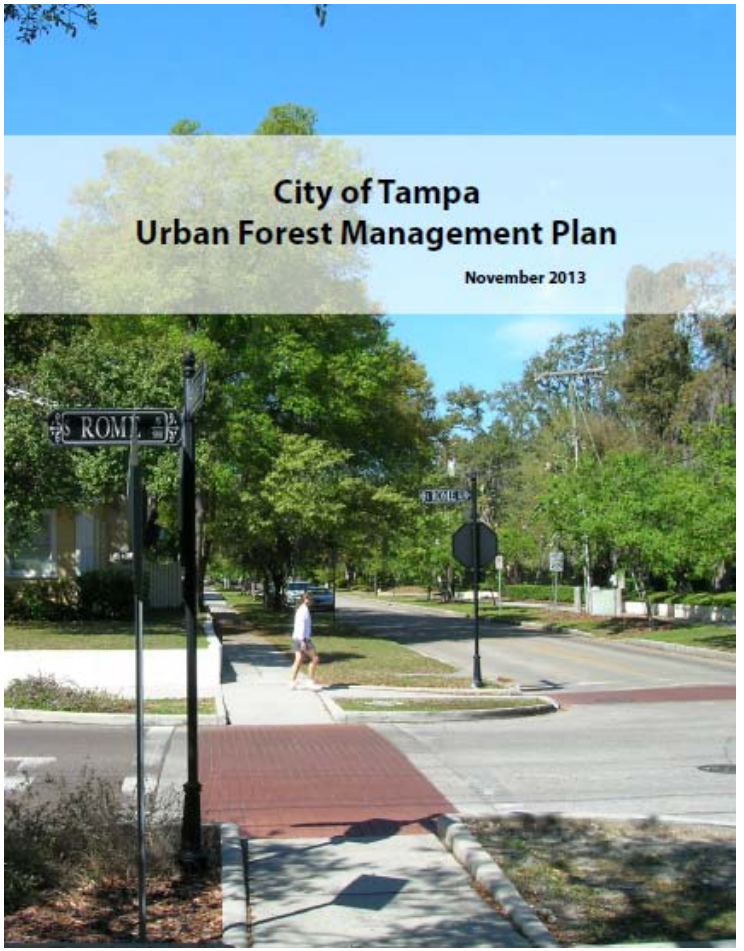
Circa 1820 vegetation map shows extensive pine forests in the Tampa area (Lee 1979)

Tampa's Changing Urban Forest

- Pre-1930s: single-family neighborhoods with sidewalks and trees
- Post-WWII: suburban annexation
- 1990s-Present: densification of older neighborhoods

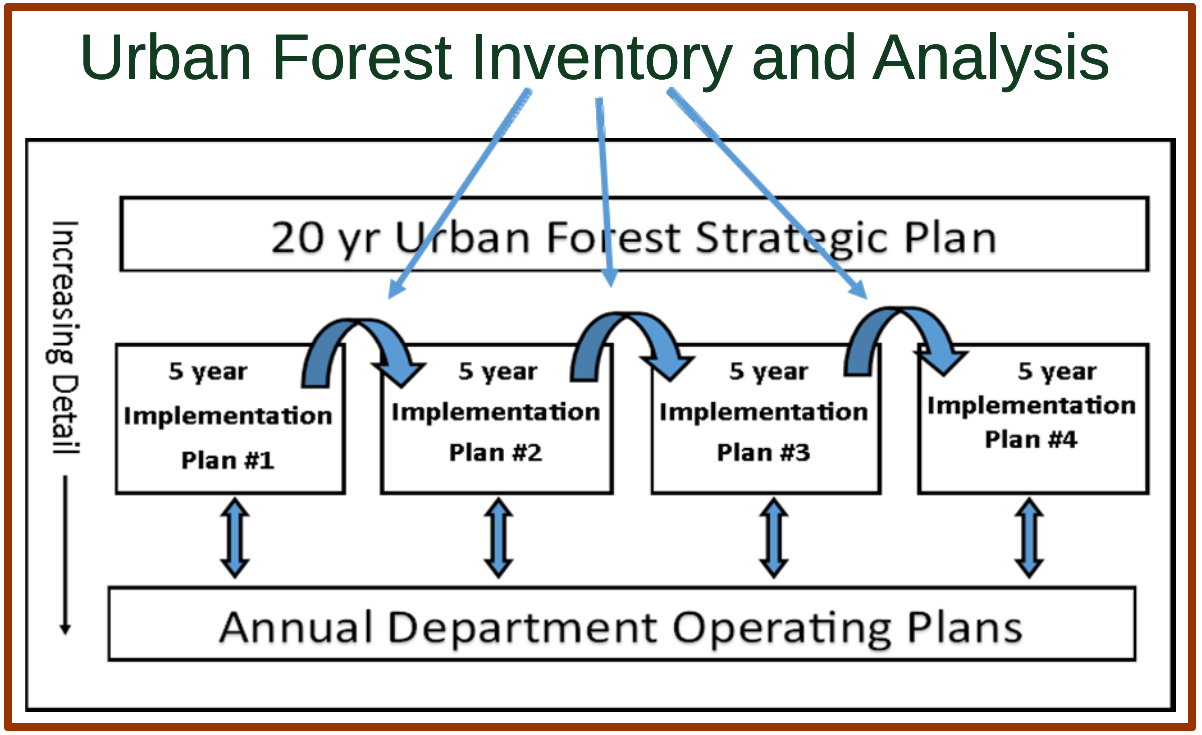
Urban Forest Management Plan Development

- June 2008 City of Tampa Mayor's Symposium on Community Trees and the Urban Forest
- 2008-2009 Mayor's Steering Committee on Urban Forest Sustainability
- 2011 Urban Forest Analysis and Management Plan Project



Adaptive Management

- Key Objectives and Criteria developed for Tampa ~ 20-year
- Implementation Plan ~ 5-year
  - Specific actions (178) expected to incrementally improve performance indicators
- Scientific Monitoring ~ 5-year



Criteria and Key Objectives - example

Criteria	Key Objective
Species suitability for Tampa's climate zones	Establish a tree population suitable for Tampa's urban environment and adapted to the regional environment.
City natural resource and forestry staffing	Employ and train adequate professional staff to implement citywide urban forest management plan.
General awareness of the urban forest as a community resource	The general public understands the importance of the urban forest to the community.
City public agency cooperation	Ensure all city departments cooperate with goals and objectives of the UFMP.

Performance Indicators - Purposeful

Performance Indicators			
Low	**Moderate**	Good	Optimal
Less than 50% of trees are of species considered suitable for Tampa.	**50%-75% of trees are of species considered suitable for Tampa.**	More than 75% of trees are of species considered suitable for Tampa.	At least 90% of the trees are of species suitable for Tampa.

Criteria: Species suitability for Tampa's climate zones

Key Objective: Establish a tree population suitable for Tampa's urban environment and adapted to the regional environment.

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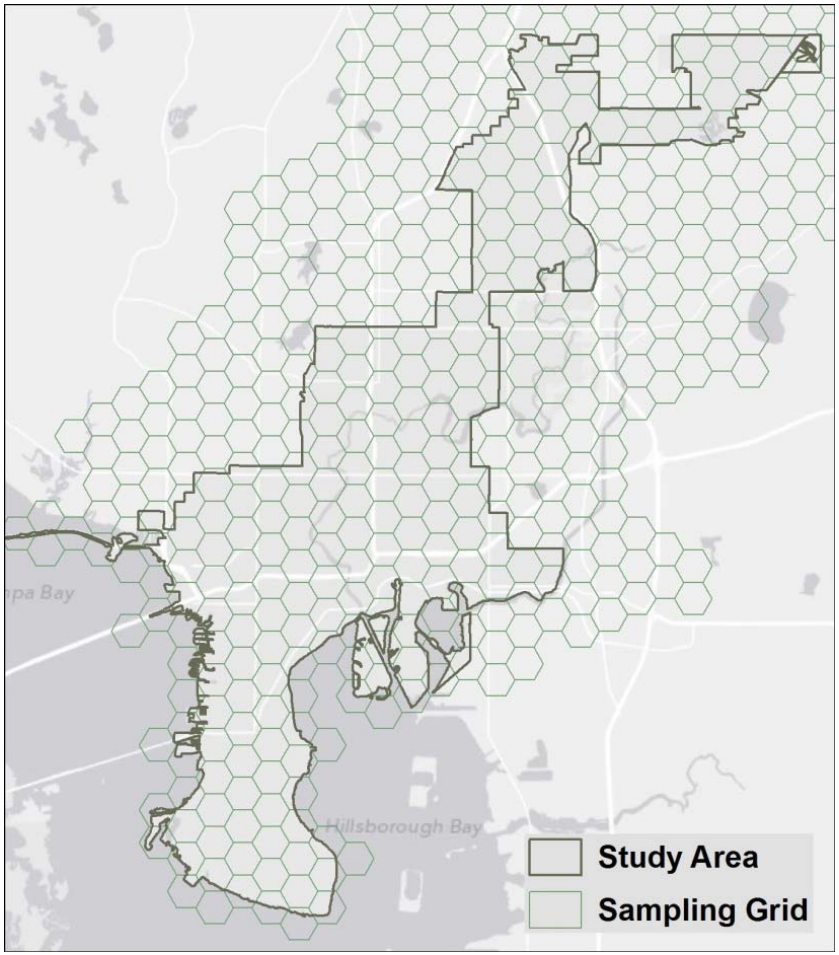
Sampling Methodology

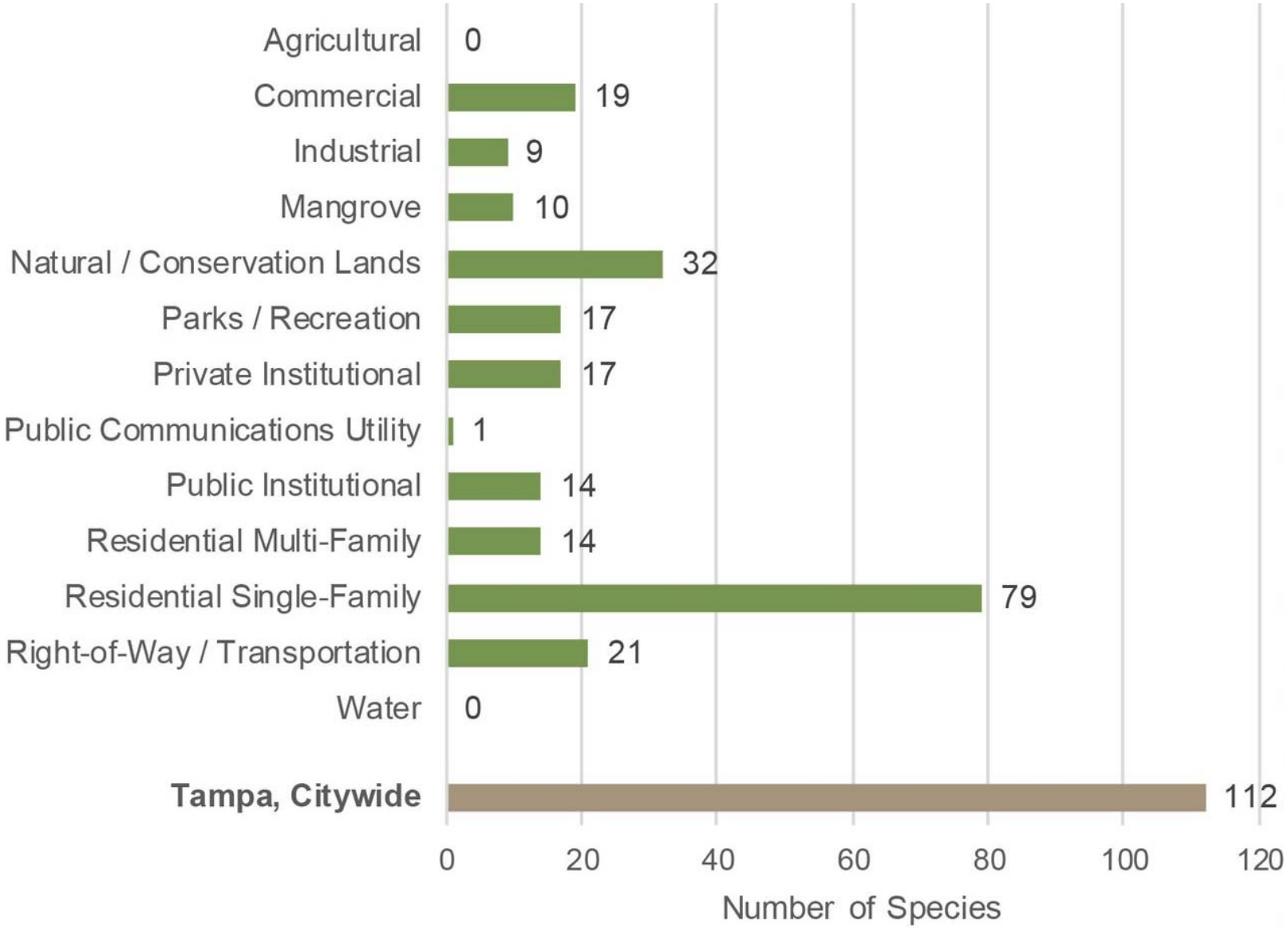


- Study boundary (city limits) was 118 square miles (75,288 acres)
- UFORE / i-Tree field permanent plots (201 random plots, 1/10 acre size)
- Plot land use used for extrapolating

Field Measurement

- Actual Land Use
- Ground Cover/Shrub Cover/Tree Cover/Plantable Space
- Tree Location
- Tree Species
- Diameter
- Height/Crown Width/Crown Base
- Live Top Height/Percent Canopy Missing/Dieback
- Impervious/Shrub Cover Beneath Canopy
- Light Exposure
- Distance/Relation to Buildings

Tree Diversity – Citywide and by Land Use



Most Common Species

17%

White mangrove
Laguncularia racemosa

11%

Cypress
Taxodium spp.

8%

Brazilian pepper
Schinus terebinthifolius

6%

Laurel oak
Quercus laurifolia

6%

Black mangrove
Avicennia germinans

Wax Myrtle
Morella cerifera

5%

Cabbage palm
Sabal palmetto

5%

Swamp tupelo
Nyssa sylvatica var. *biflora*

3%

Live oak
Quercus virginiana

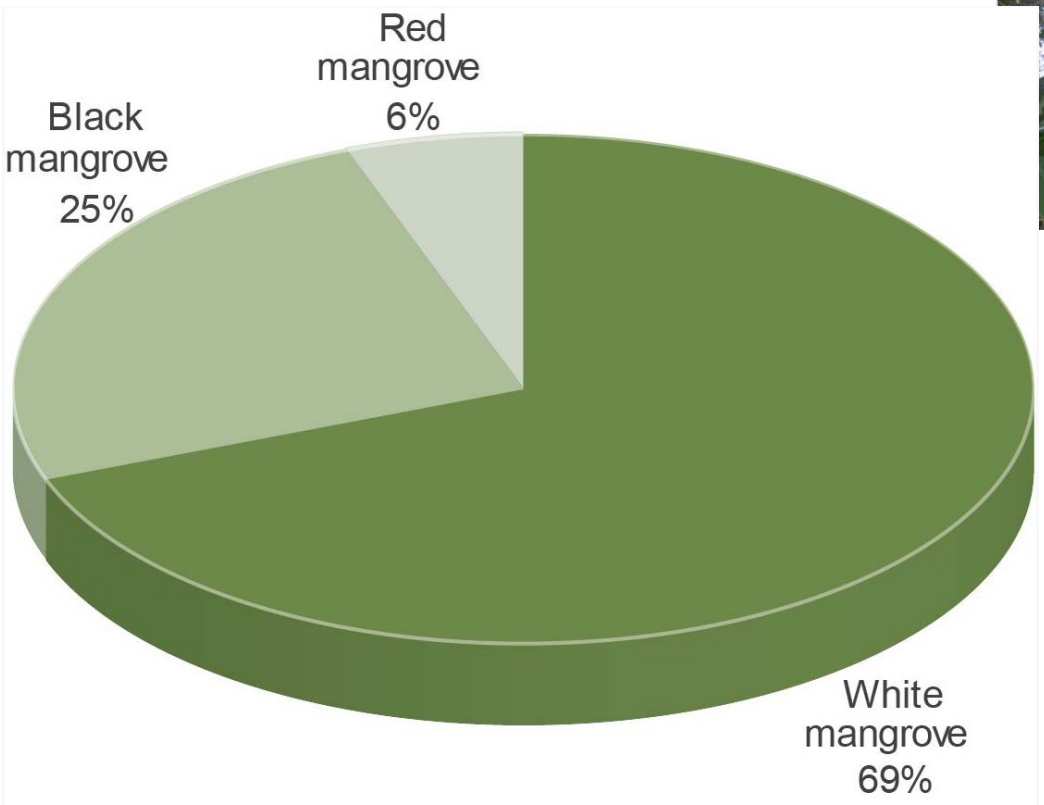
3%

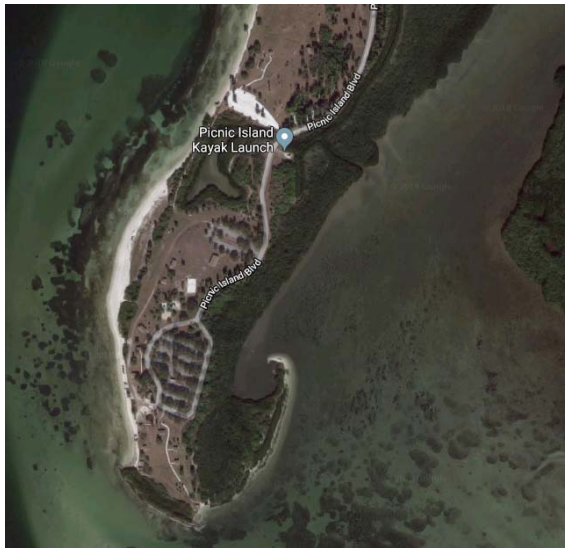
Buttonbush
Cephalanthus occidentalis

2%

Mangrove Areas

- Mangroves (all species) account for 1 in 5 trees in Tampa
- Mangroves only comprise 2.7% of Tampa's urban forest canopy

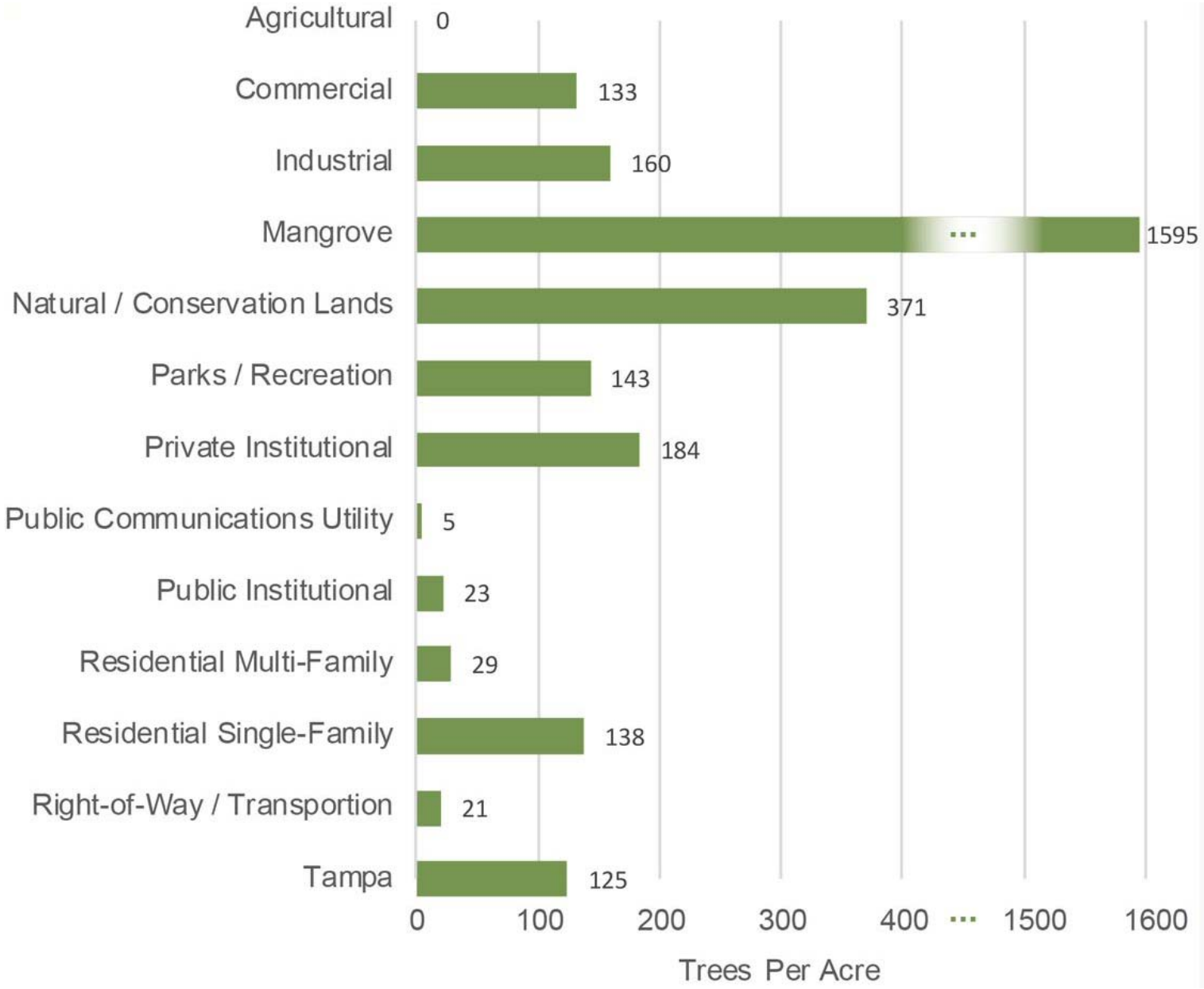




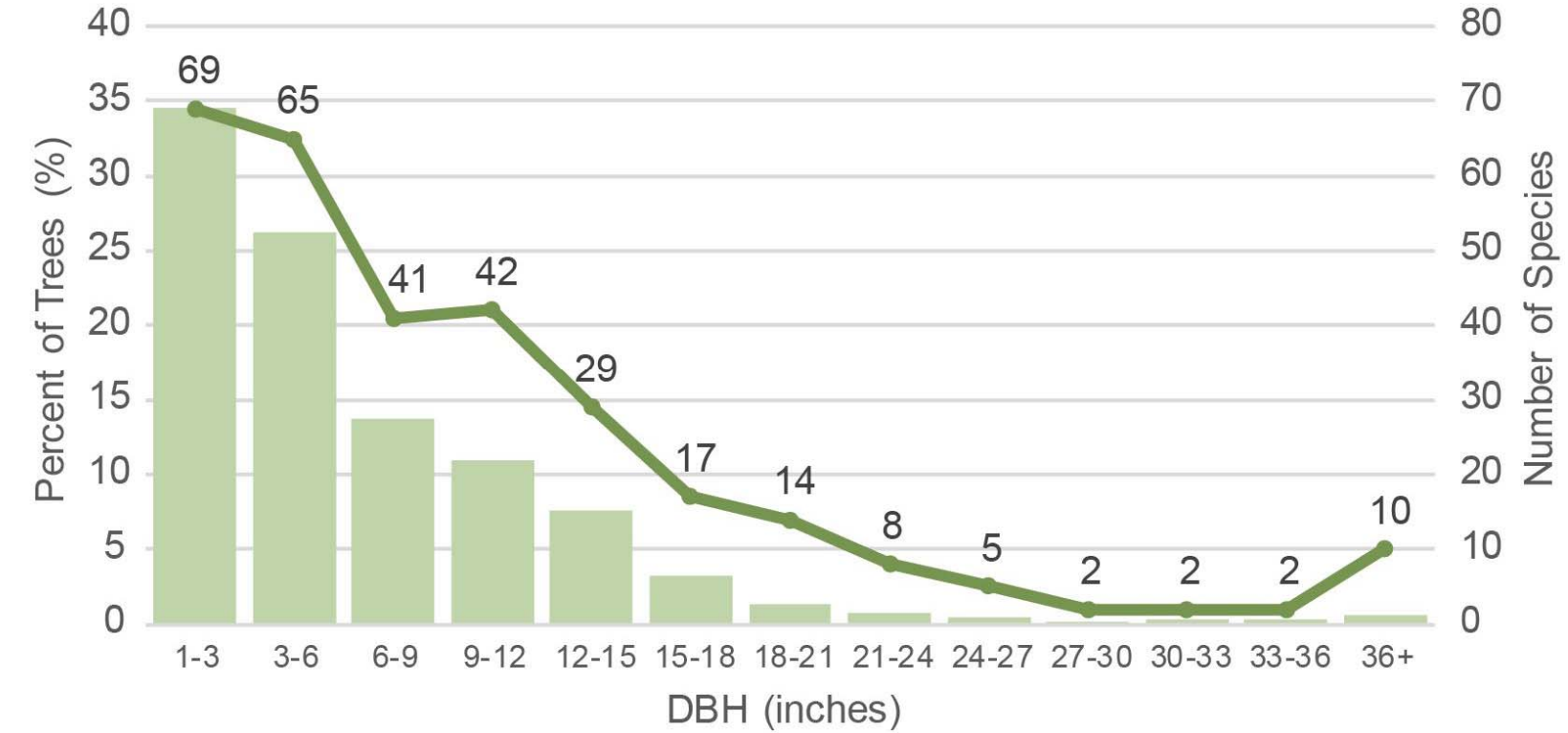
Species Diversity Performance Criteria

Criteria	Vegetation Resource – Performance Indicators				Key Objective
	Low	Moderate	Good	Optimal	
Species suitability for Tampa's climate zones	Less than 50% of trees are of species considered suitable for Tampa.	**50%-75% of trees are of species considered suitable for Tampa.**	More than 75% of trees are of species considered suitable for Tampa.	At least 90% of the trees are of species suitable for Tampa.	Establish a tree population suitable for Tampa's urban environment and adapted to the regional environment.
Tree species diversity	Fewer than five species dominate the entire tree population citywide.	No species represents more than 20% of the entire tree population citywide.	**No species represents more than 15% of the entire tree population citywide.**	No species represent more than 10% of the entire tree population citywide.	Establish a diverse tree population citywide.
Wind resistance of tree species citywide.	Majority of trees are rated in lowest category of wind resistance.	**Majority of trees are rated in medium and high categories of wind resistance.**	Majority of trees are rated in high category of wind resistance.	Greater than 80% of trees are rated in highest category of wind resistance.	Reduce disruption of social and economic services; reduce cost of cleanup and protect private property and human well being.
Tree species longevity	Less than 25% of trees are of species considered long-lived for Tampa.	**25% to 49% of trees are of species considered long-lived for Tampa.**	50%-75% of trees are of species considered long-lived for Tampa.	More than 75% of trees are of species considered long-lived for Tampa.	Establish a long-lived tree population that maximizes benefits vs. costs

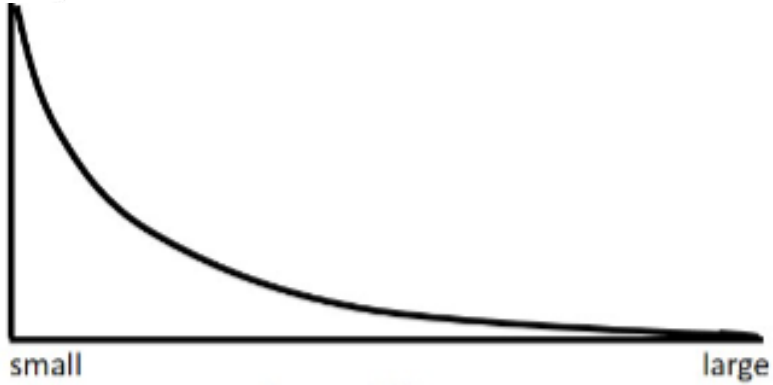
Tree Density – Citywide and by Land Use



Diameter Distribution of Trees (Mangroves Omitted)

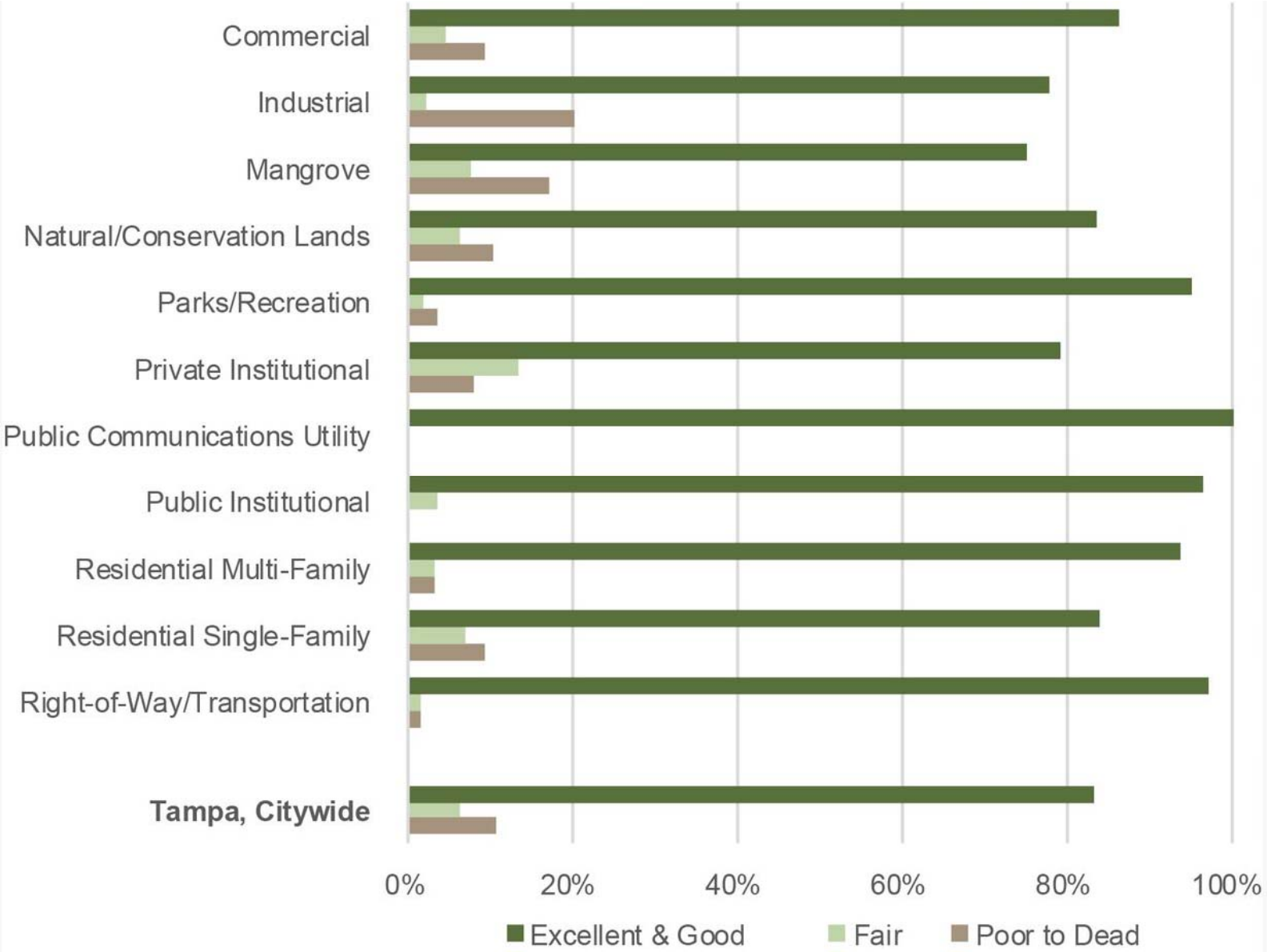


Type I – Young Population

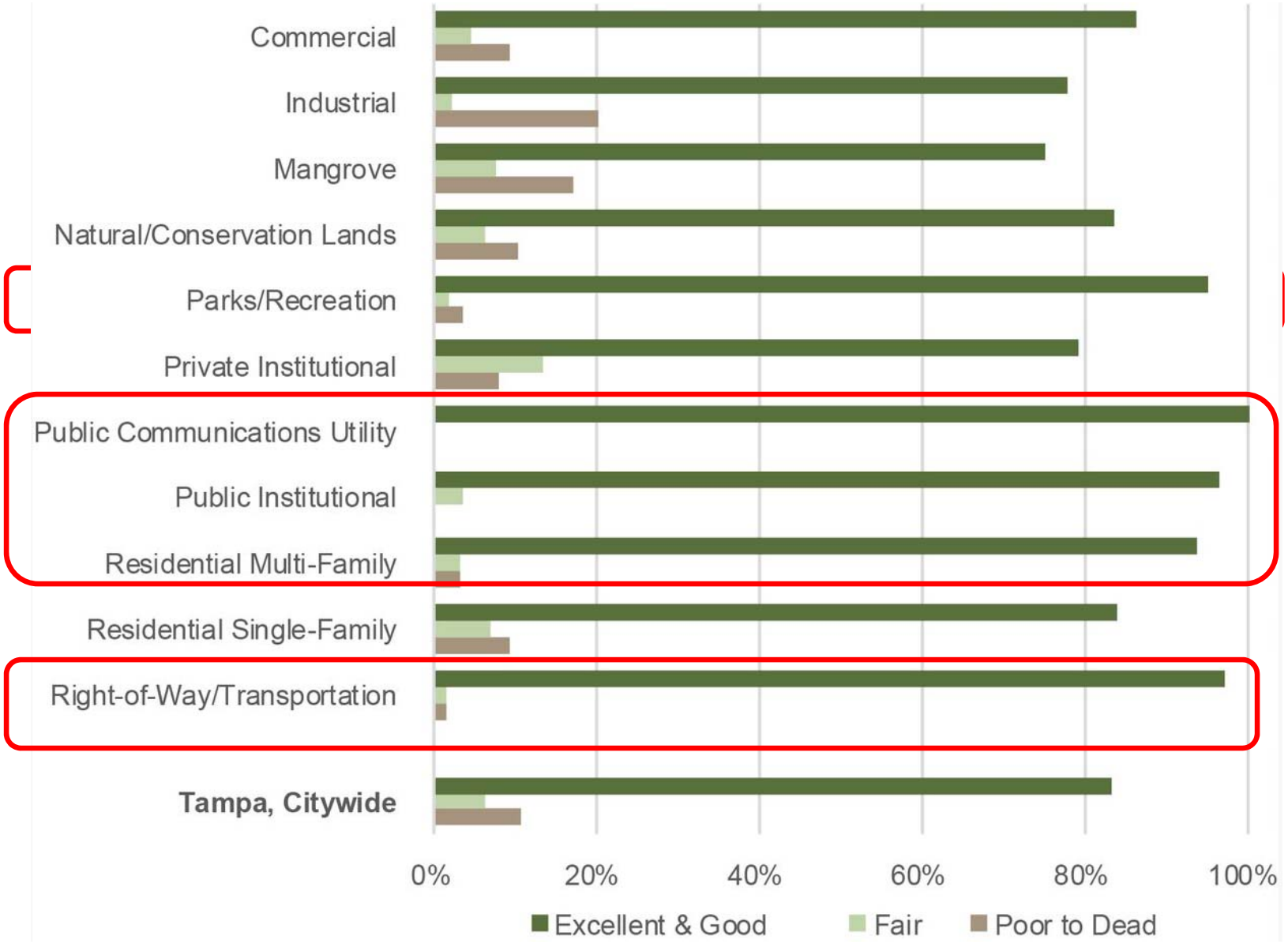


Stem Diameter

Tree Health – Citywide and by Land Use



Tree Health – Citywide and by Land Use



Tree Health Performance Criteria

Criteria	Vegetation Resource - Performance Indicators				Key Objective
	Low	Moderate	Good	Optimal	
5 Tree health condition by municipal planning district.	Less than 30% of trees rated as excellent health condition.	31 - 60% of trees rated as excellent health condition.	61 - 85% of trees rated as excellent health condition.	Greater than 85% of trees rated as excellent health condition in all municipal planning districts.	Healthy trees live longer, produce greater no. of benefits and reduce costs associated with maintenance.

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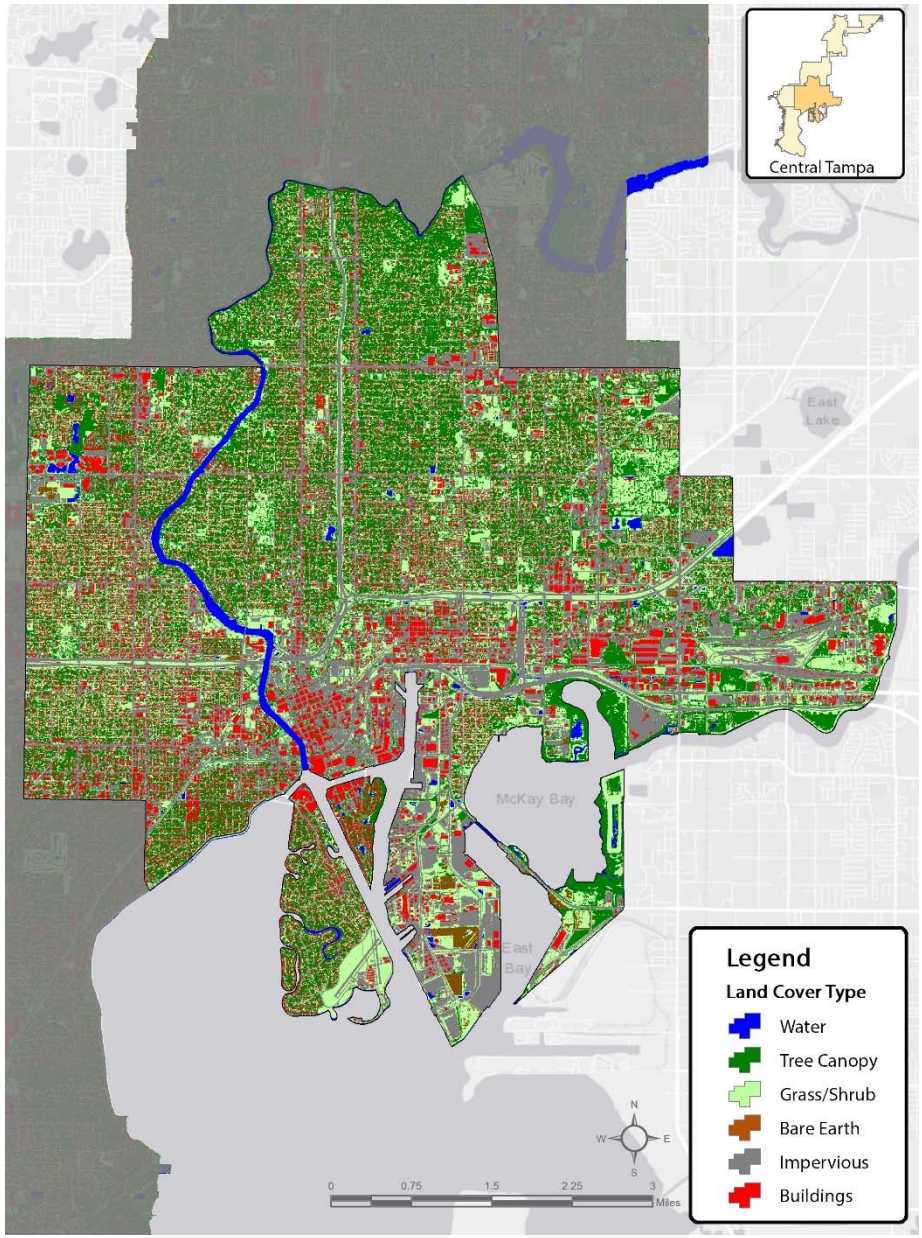
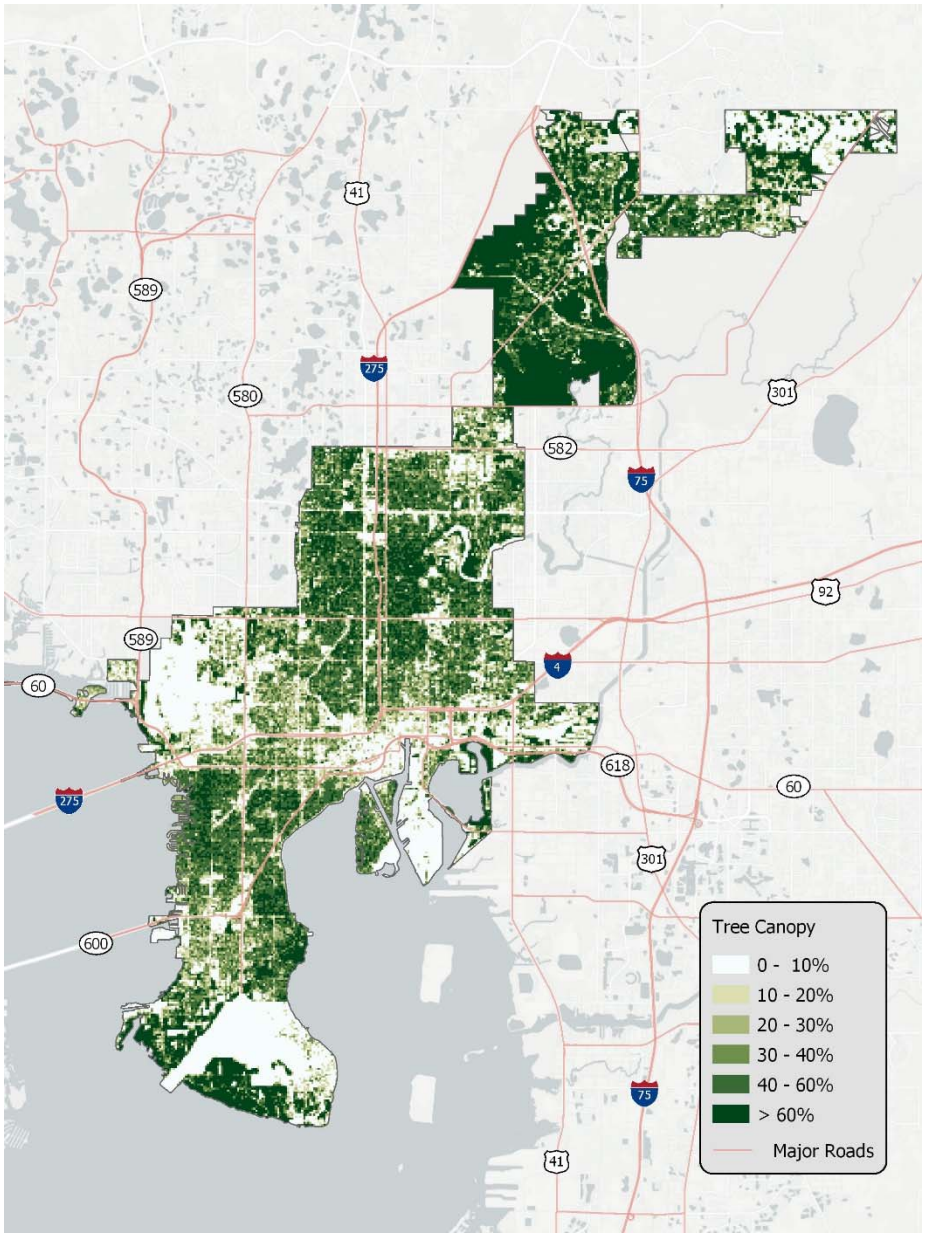
Tree Canopy Cover

- Tree Canopy Mapping:
  - Where are trees located within the City of Tampa?
  - Where are the opportunities for tree planting?
- Tree Canopy Change:
  - How and where is the urban forest changing over time?

Tree Canopy Mapping: Object-based Image Analysis

Mapped every 6 inches of Tampa (with 92% Accuracy)





Mapped every 6 inches of Tampa (with 92% Accuracy)

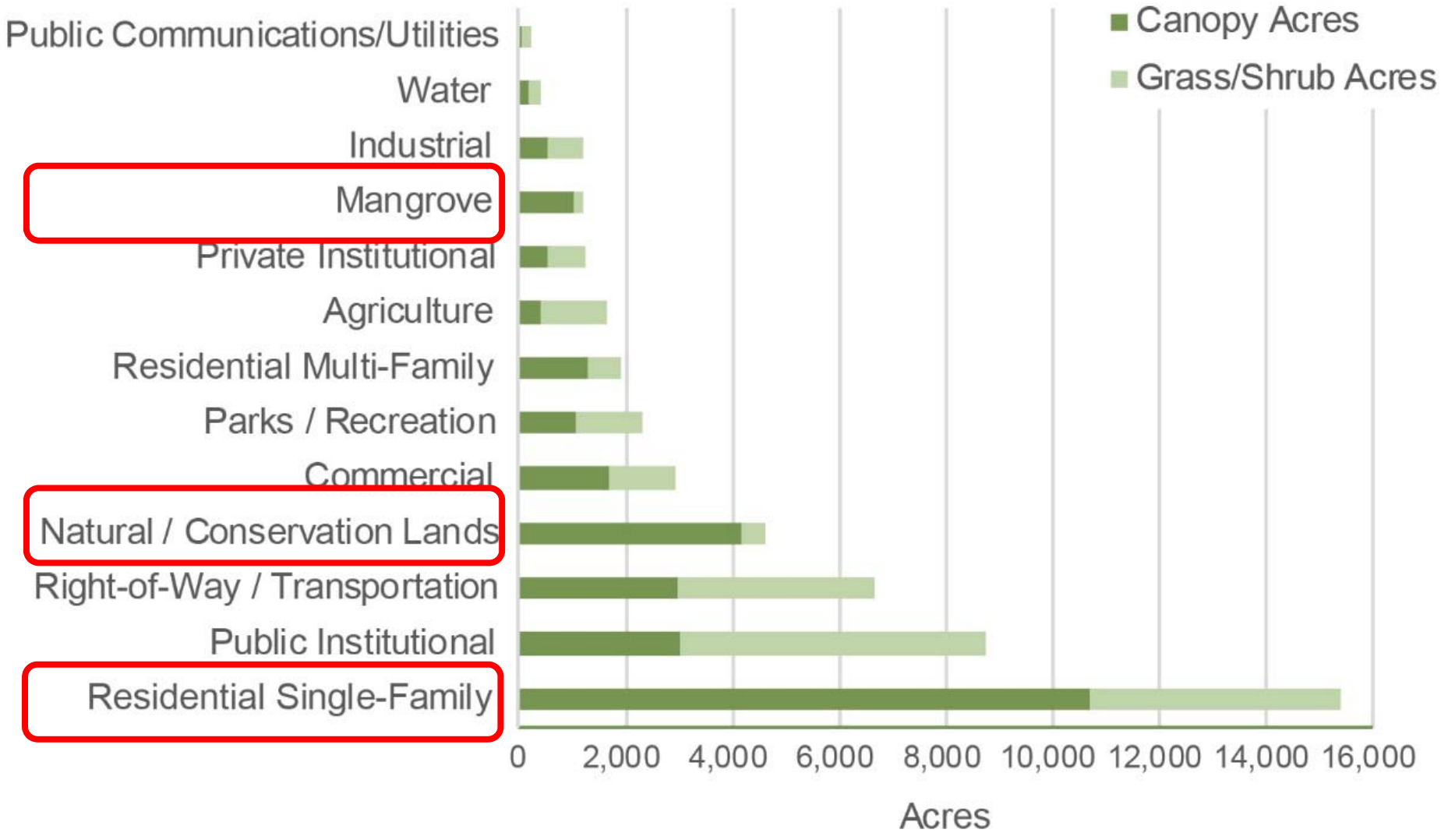
Tree canopy can be summarized by parcel, zoning, land use, etc.

% Canopy & Grass/Shrub by Current Use of Land

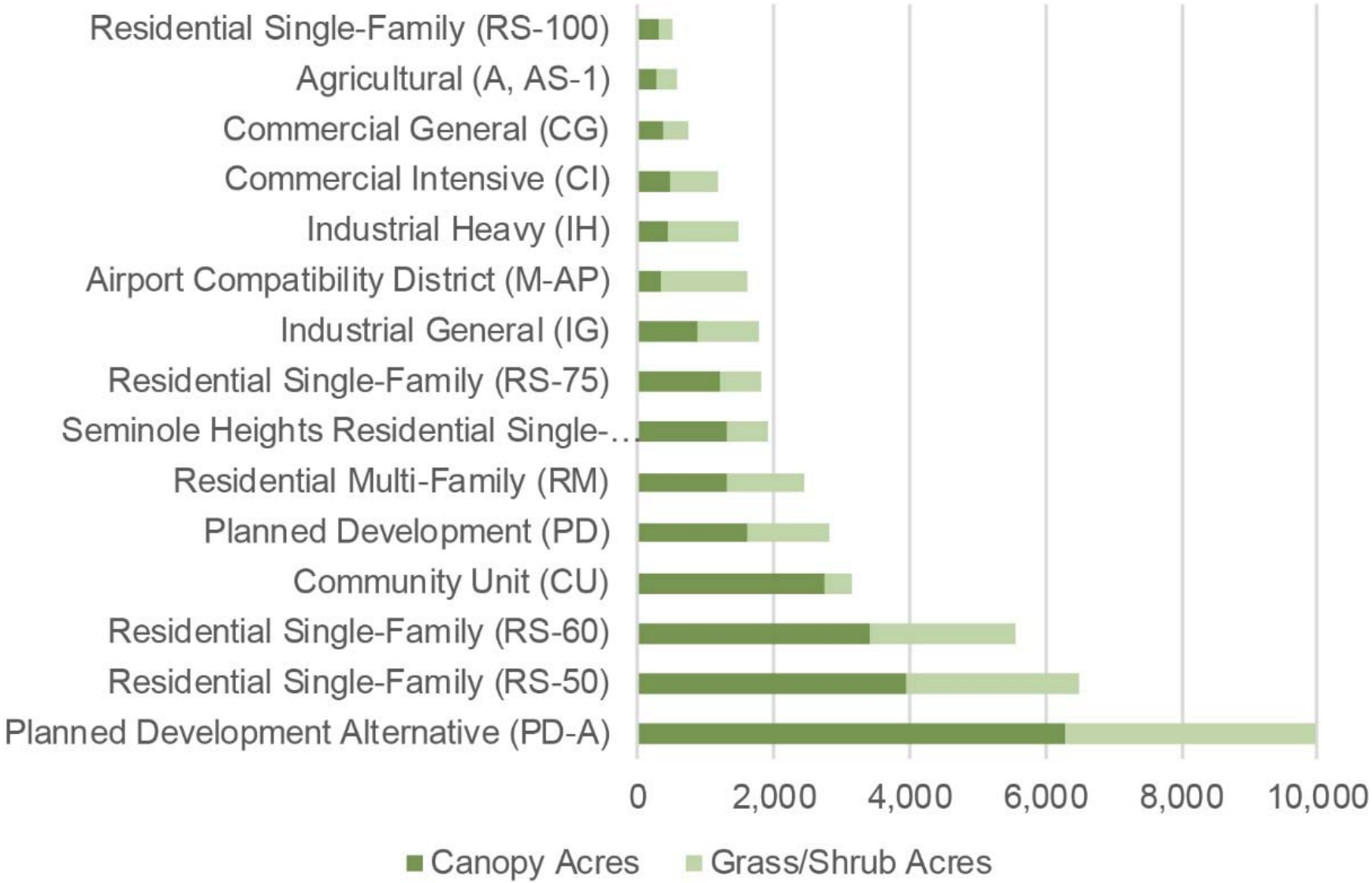
Current Use of Land STRATA	Total Acres	Tree Canopy	Grass/ Shrub	Bare Earth	Impervious	Water
Agriculture	1,679	25%	73%	1%	0%	1%
Commercial	6,933	24%	18%	1%	57%	0%
Industrial	2,968	17%	23%	1%	58%	1%
Mangrove	1,218	84%	15%	0%	0%	1%
Natural / Conservation Lands	4,657	89%	10%	0%	0%	0%
Parks / Recreation	2,553	42%	48%	1%	7%	1%
Private Institutional	2,343	23%	30%	1%	45%	1%
Public Institutional	13,043	23%	44%	2%	30%	1%
Public Communications/Utilities	343	17%	51%	1%	31%	0%
Residential Multi-Family	3,374	38%	18%	0%	43%	1%
Residential Single-Family	20,749	51%	23%	0%	25%	0%
Right-of-Way / Transportation	13,022	23%	28%	0%	48%	0%
Water	2,406	7%	10%	0%	1%	82%

- % Tree Canopy is highest in Mangroves, Natural Areas and Residential Single-Family
- Most land uses have possible space to increase tree canopy – indicated by grass/shrub

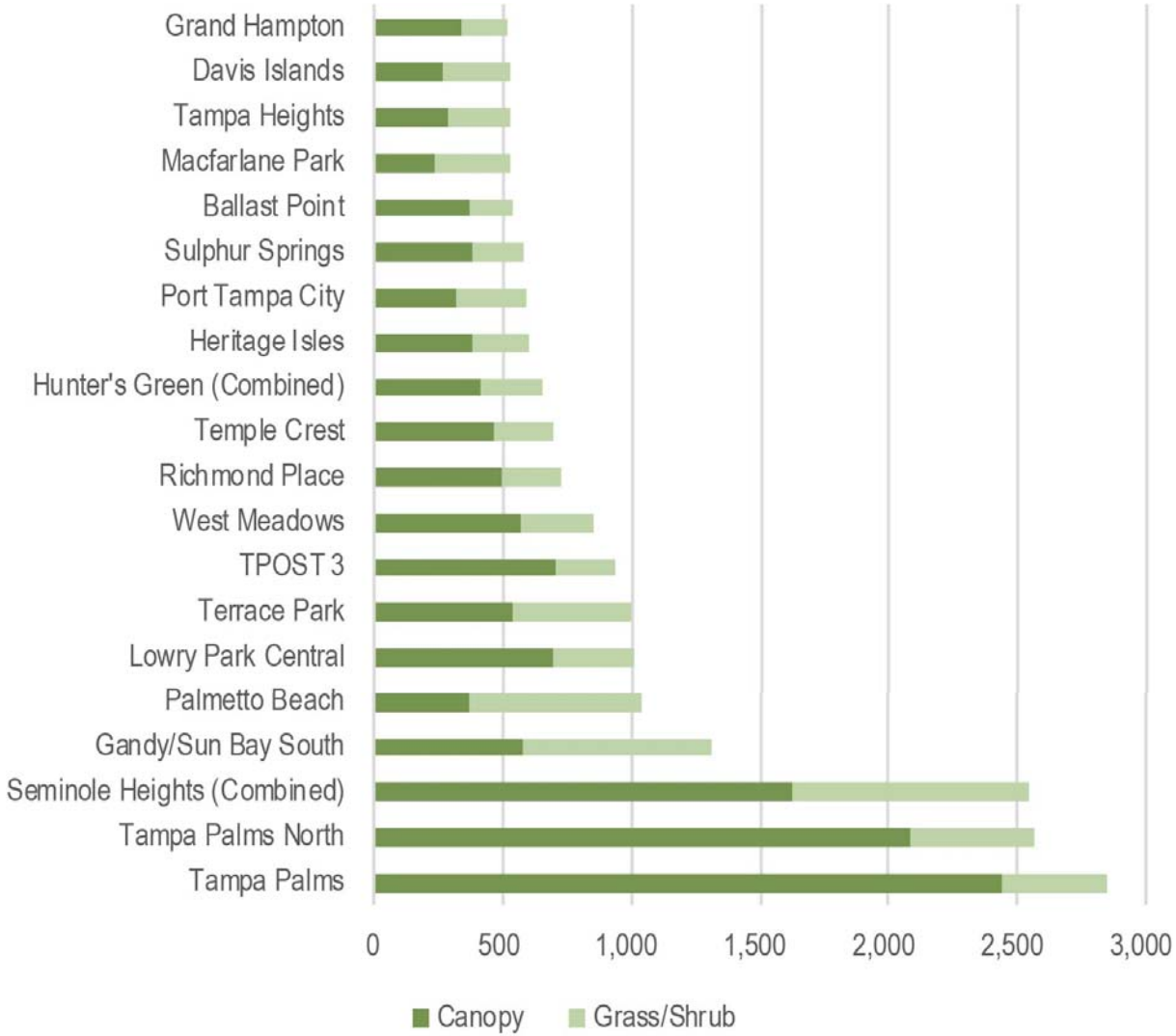
Acres Canopy & Grass/Shrub by Current Use of Land



Zoning Categories with >500 Acres of Vegetation



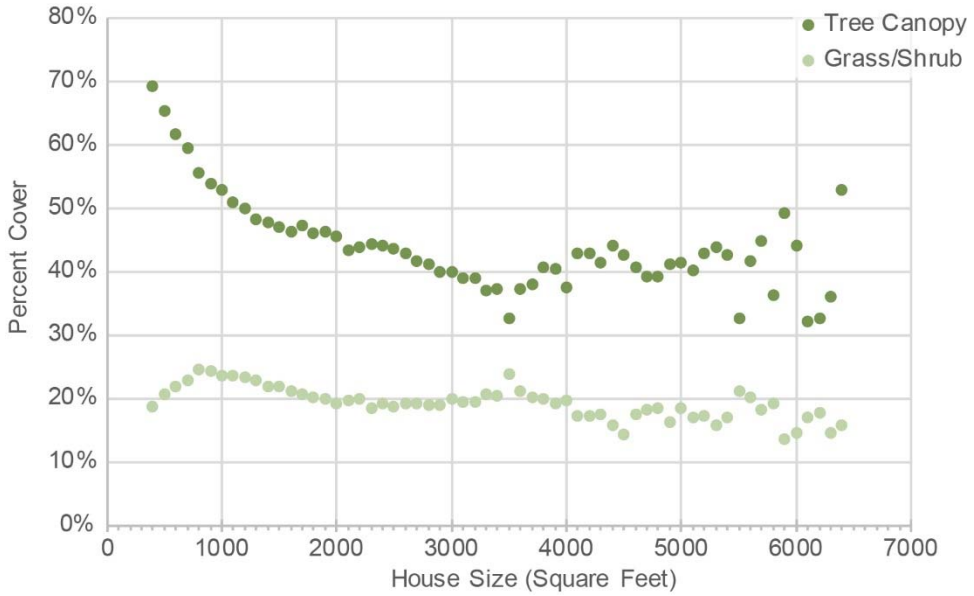
Neighborhood Associations with >500 Acres of Vegetation



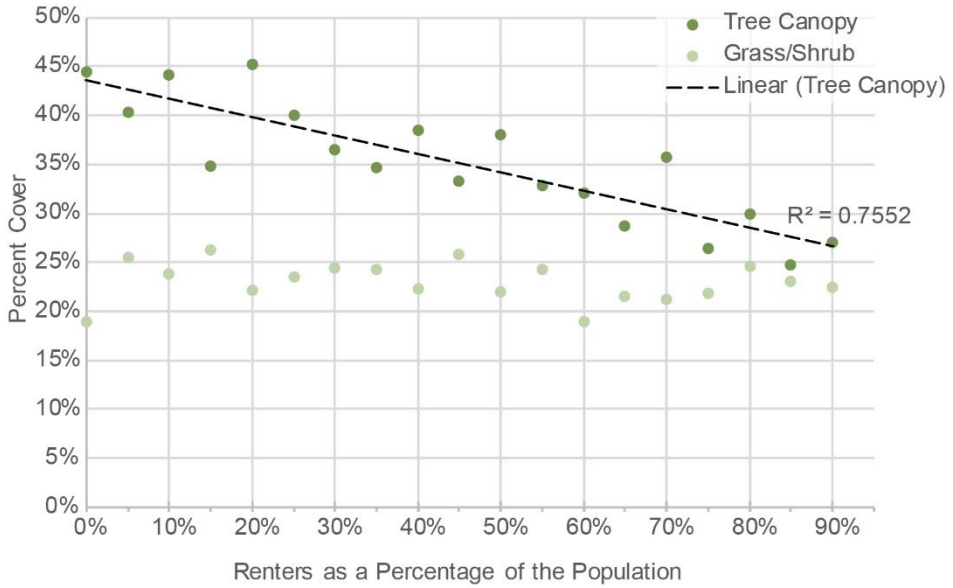
- Neighborhood based on City Of Tampa Official Neighborhood Registry
- All 97 Neighborhood Associations are listed in the report

Using Data to Answer Questions – Two Examples

- Does % tree canopy decrease when house size increases?
  - Analysis of 80,000+ Parcels



- Is there less tree canopy in neighborhoods with a higher proportion of renters?
  - Analysis of 326 Census Block Groups



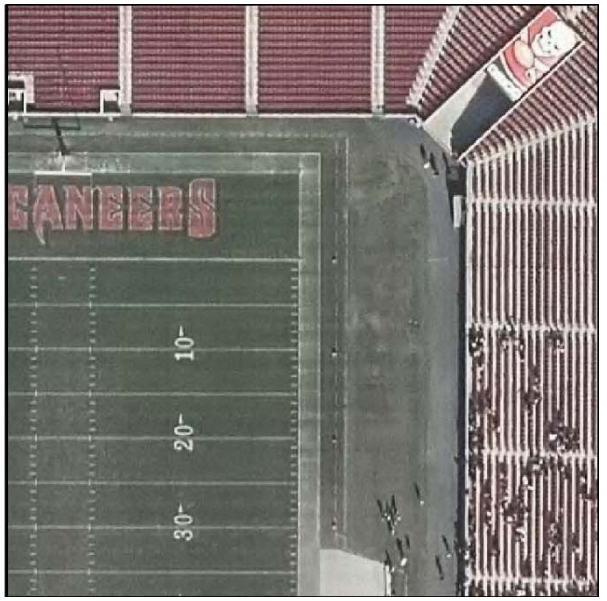
Tree Canopy Change

- Tree canopy mapping has improved for each Tampa Analysis
  - Example - we could map smaller trees in 2016 that were not detected in 2011 or 2006
  - Measuring change over time requires a consistent and comparable method

2006

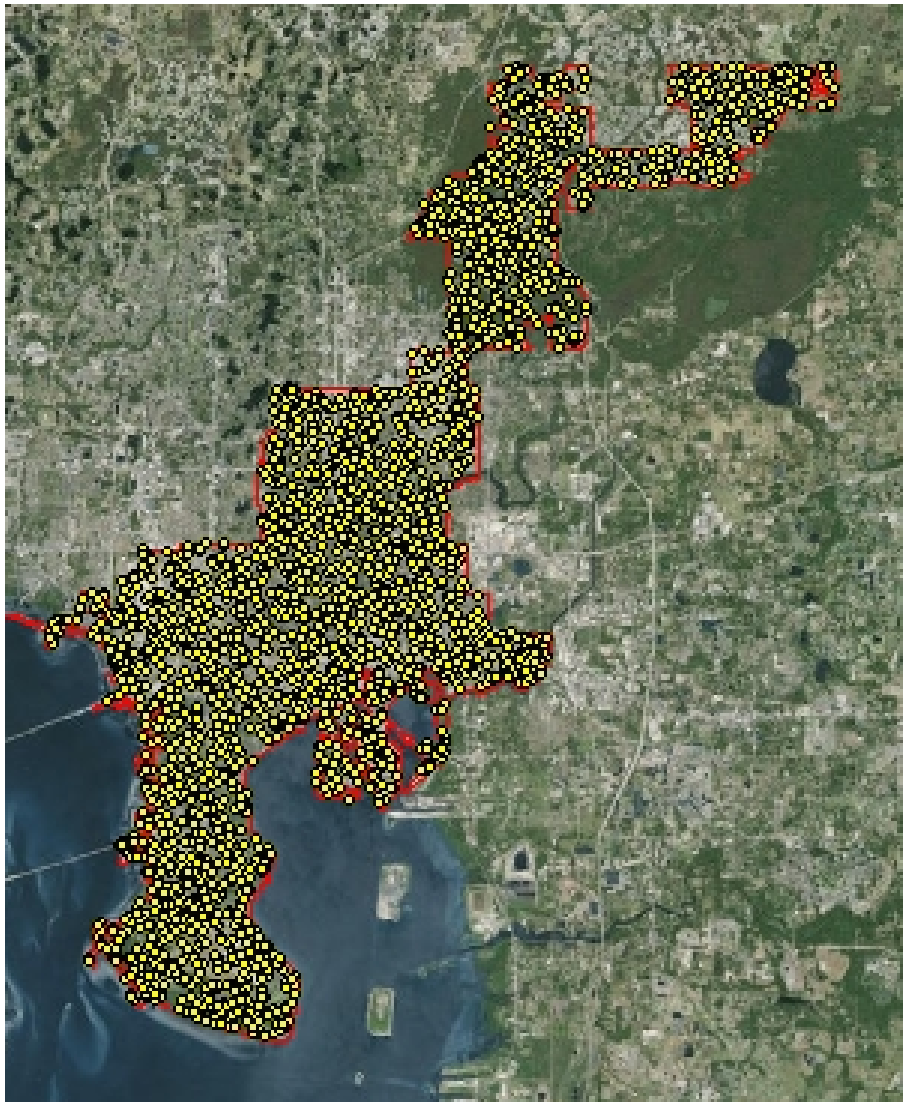
2011

2016



Tree Canopy Change: Dot-based Method

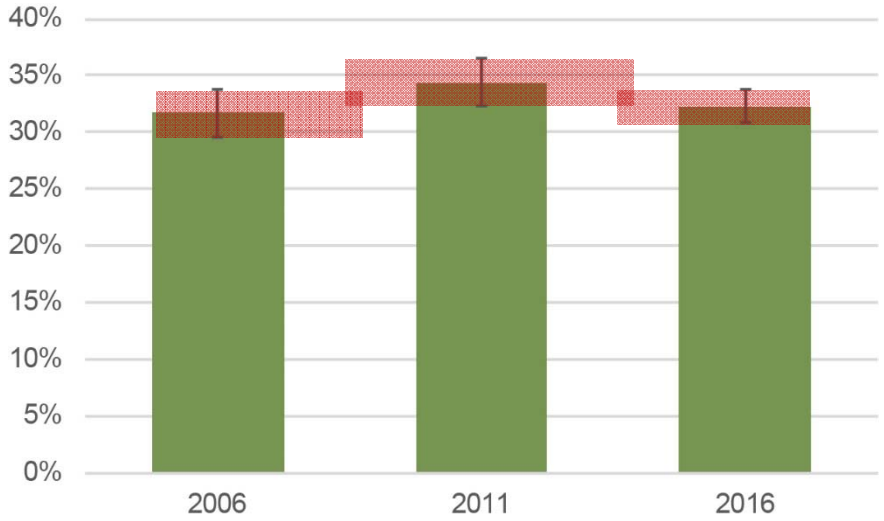
- U.S. Forest Service methods
- 4,000+ points randomly located in Tampa
- Two independent technicians evaluated each point as "Canopy" or "No Canopy"



Try this for your neighborhood: i-Tree Canopy at itreetools.org

Citywide Tree Canopy Change 2006-2016

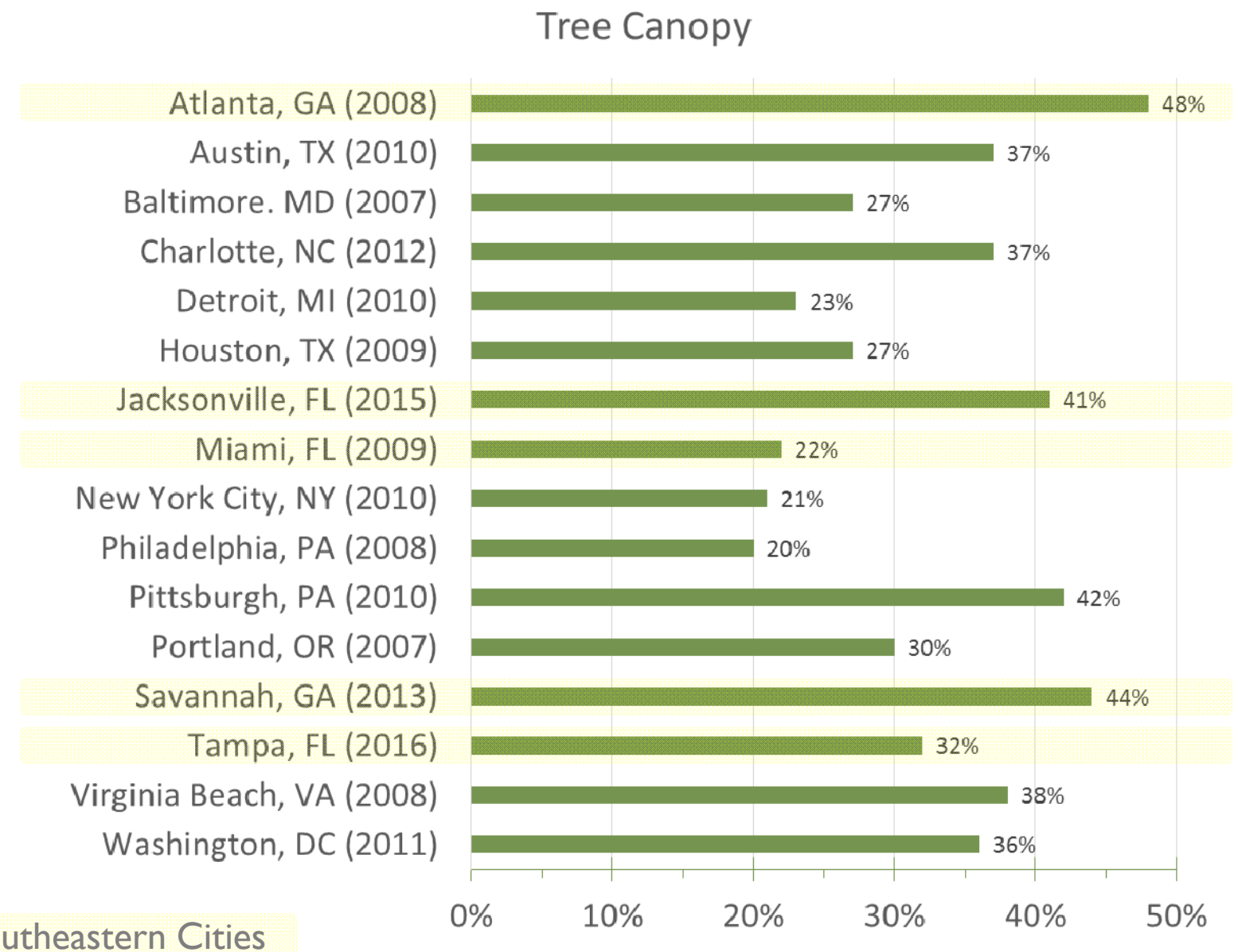
Percent Tree Canopy with Error Shown as 95% Confidence Interval



Year	Tree Canopy	95% Confidence Interval
2006	31.7%	CI = 29.6 - 33.8 %
2011	34.4%	CI = 32.2 - 36.5 %
2016	32.3%	CI = 30.9 - 33.7 %

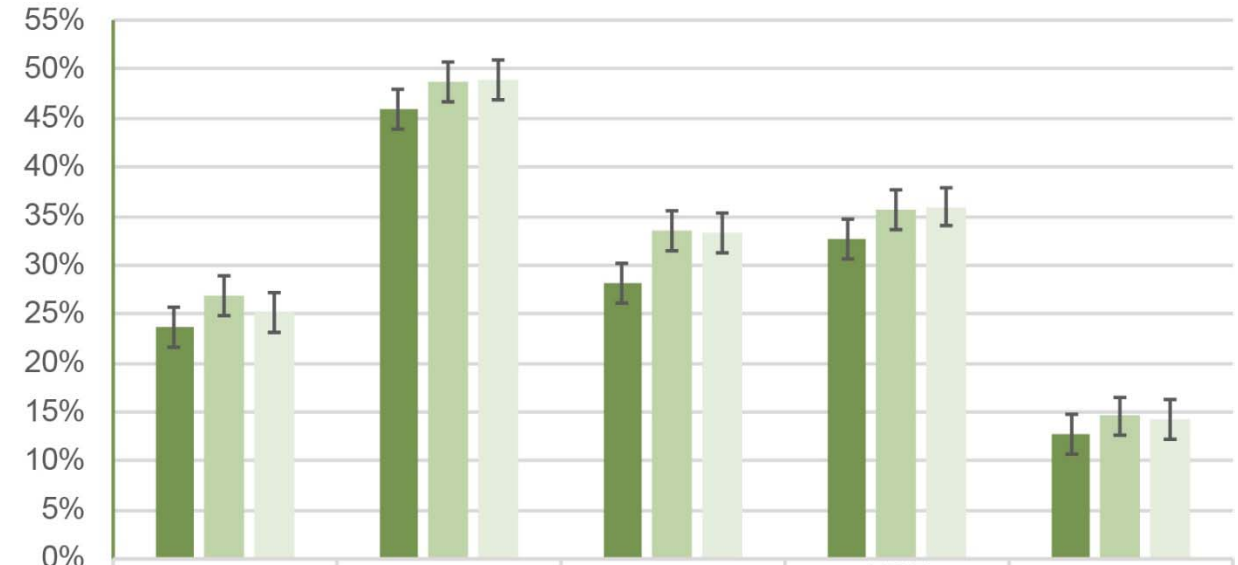
- Estimates of tree canopy overlap slightly from 2006 to 2011 to 2016
  - We cannot say with 100% certainly that tree canopy changed
- *Increase* in Tree Canopy 2006 to 2011
- *Slight decline* in Tree Canopy 2011 to 2016

How does Tampa compare to other U.S. Cities?

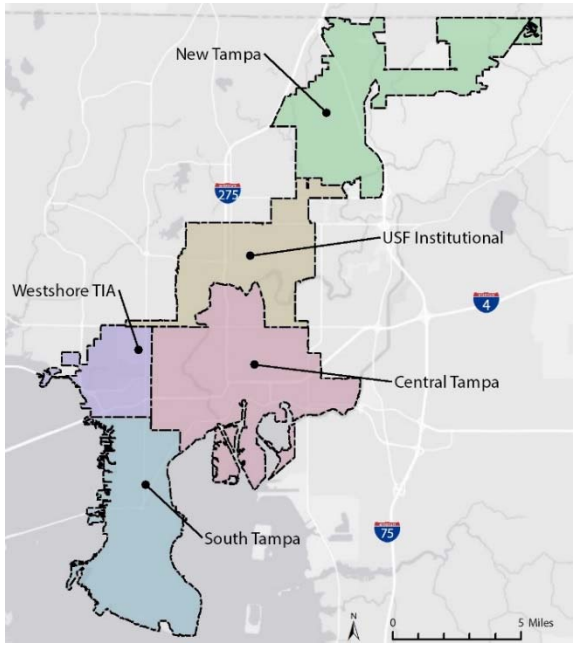


Southeastern Cities

Tree Canopy Change by Planning District



	Central Tampa	New Tampa	South Tampa	USF Institutional	Westshore TIA
2006	23.7%	46.0%	28.2%	32.6%	12.7%
2011	26.9%	48.7%	33.5%	35.7%	14.6%
2016	25.2%	49.0%	33.3%	36.0%	14.2%



- Slight increase from 2006-2011in all areas
- Minimal increase from 2011-2016 in New Tampa and USF Institutional
- Minimal decrease from 2011-2016 in Central Tampa, South Tampa & Westshore TIA

Urban Forest Management Plan Performance Criteria

Canopy cover relative to goals by municipal planning district

- The City of Tampa Urban Forest Management Plan recommends "No net loss of canopy cover by municipal planning district" as a performance criteria for the vegetation resource.

Criteria	Vegetation Resource – Performance Indicators				Key Objective
	Low	Moderate	Good	Optimal	
Canopy cover relative to goals by municipal planning district	The existing canopy cover equals 0%-25% of the goal.	The existing canopy cover equals 25%-50% of the goal.	The existing canopy cover equals 50%-75% of the goal.	The existing canopy cover equals 75%-100% of the goal.	Relative canopy cover to goal for each municipal planning district category. The goal is defined as no net loss in a Planning District.

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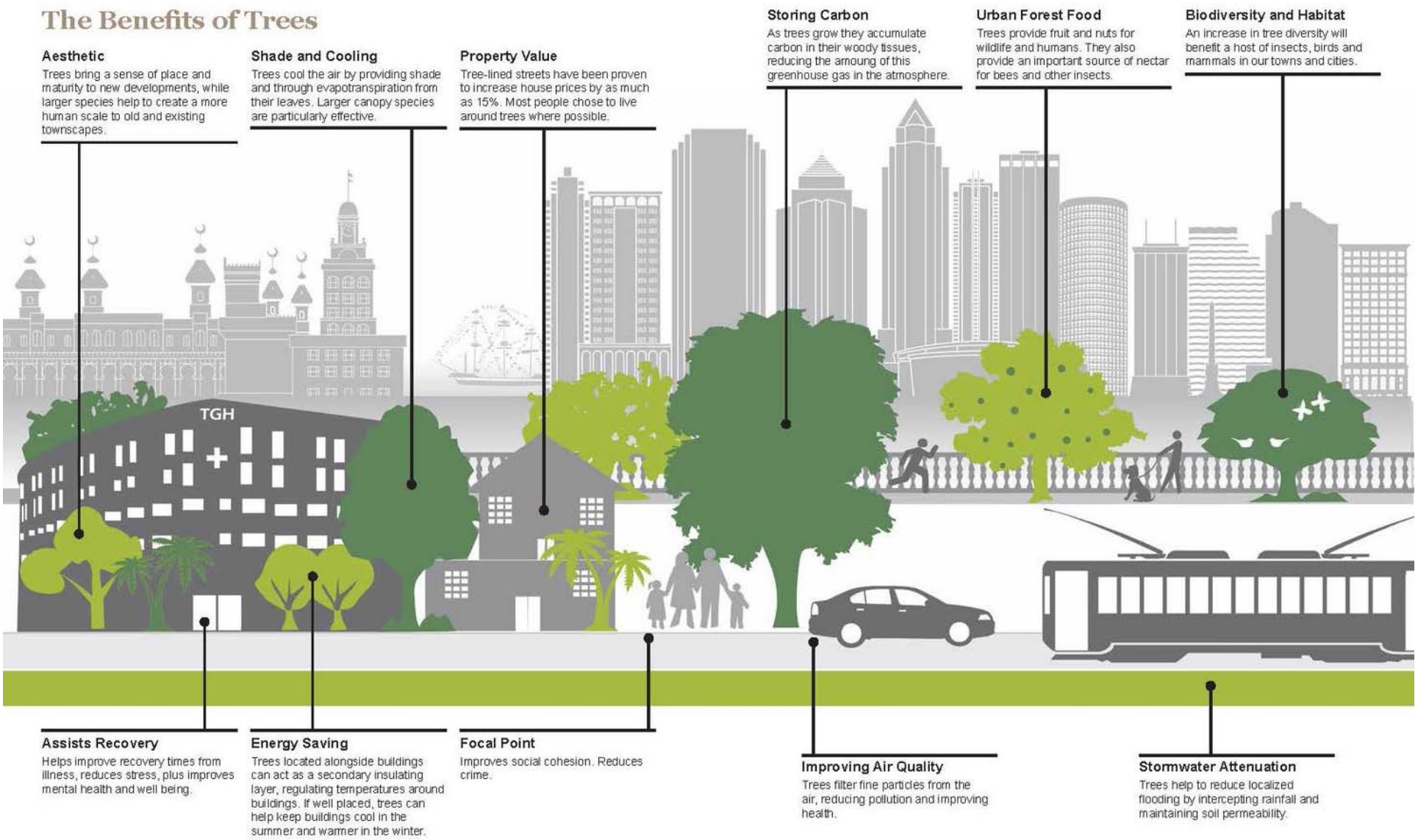
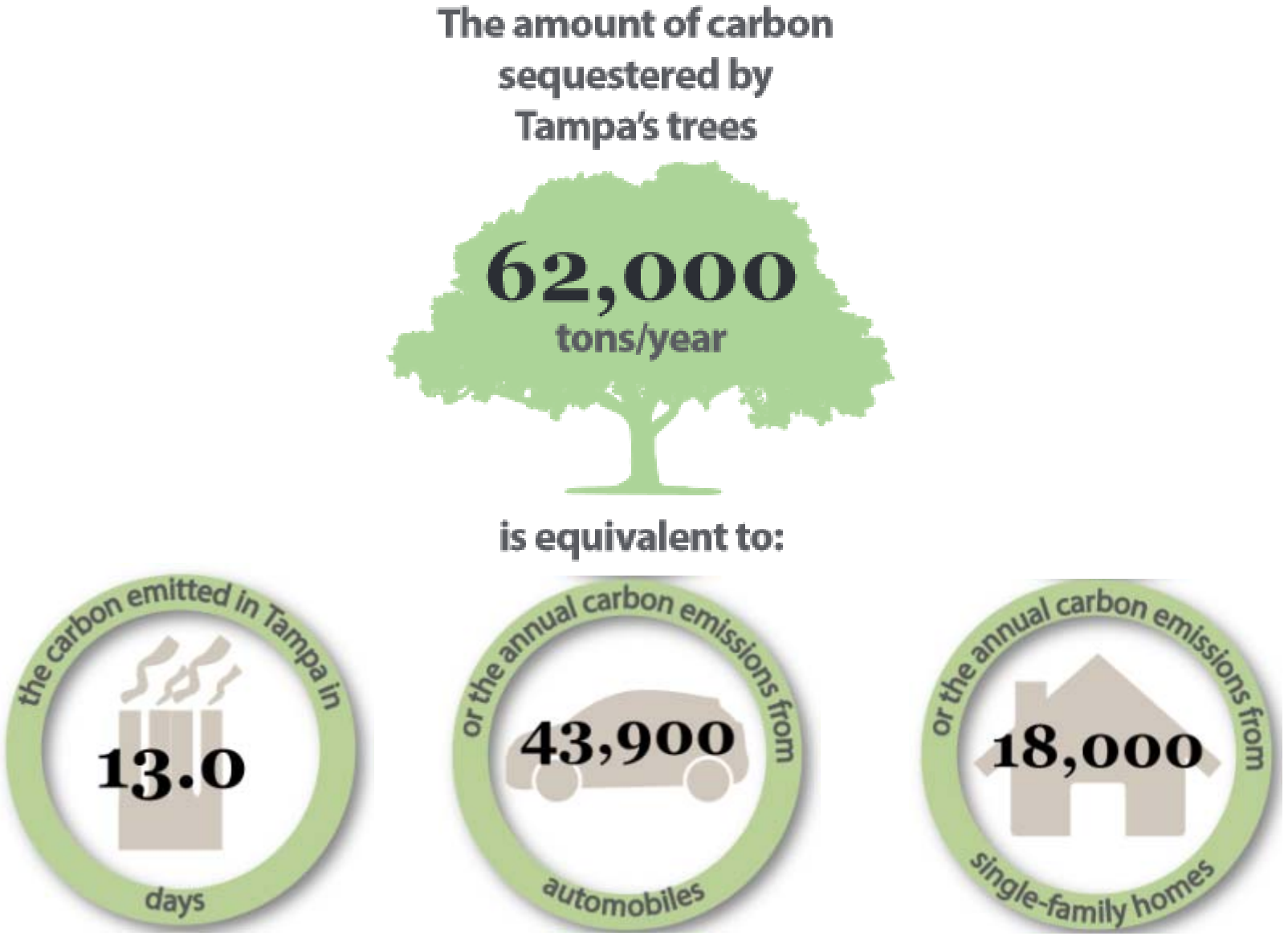
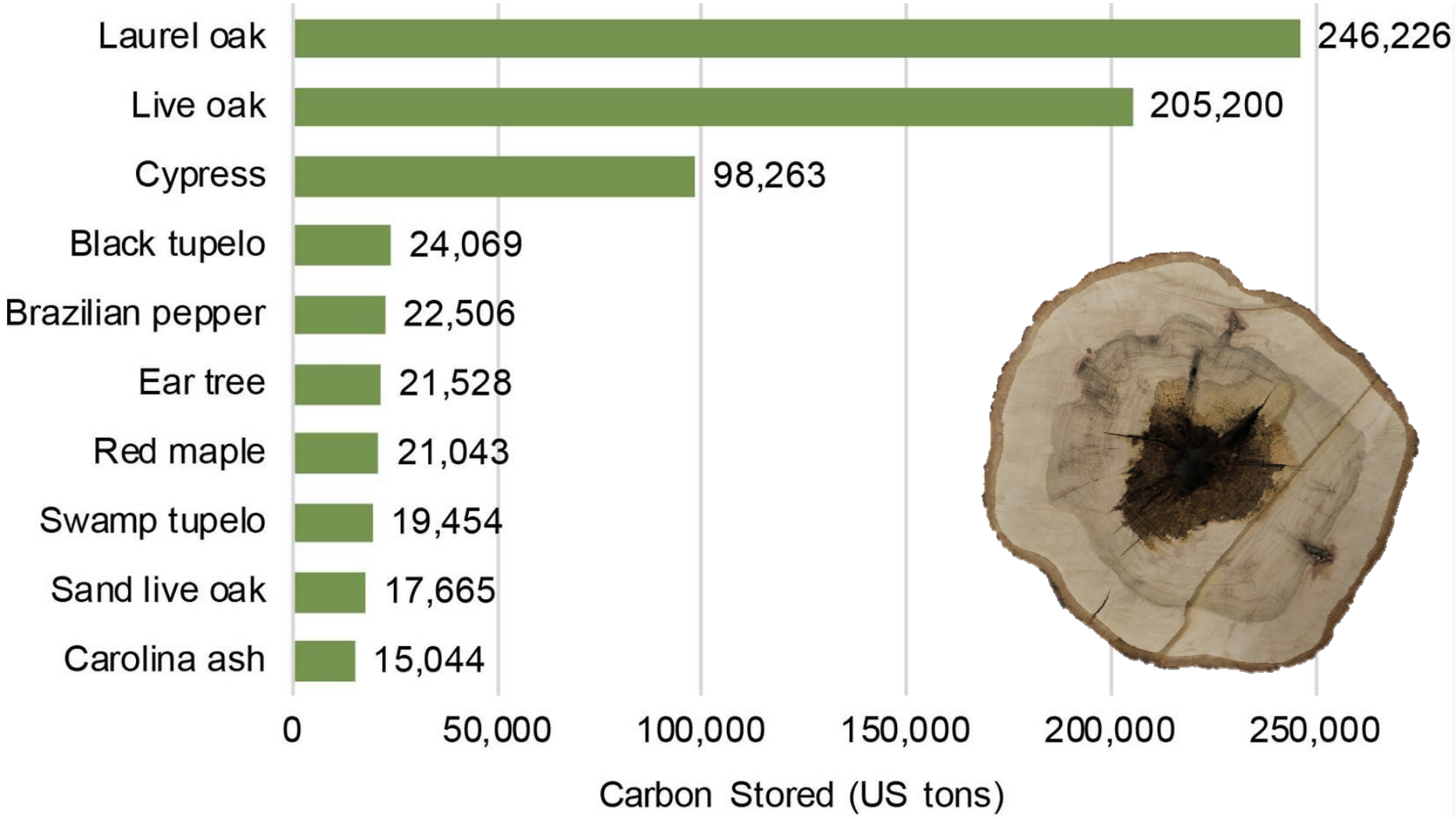
Urban Forest Ecosystem Services



Carbon Sequestration



Carbon Storage



Energy Savings

Steven H. Keys and KeysPhotography.com

Annual energy savings and associated dollar values due to the proximity of residential buildings to trees in 2016.

Type	Heating	Cooling	Total	Price ($)	Value ($)
Natural Gas (MBtu)[a]	(22,058)	n/a	(22,058)	$17.30	($381,664)
Electricity (MWh)[b]	(1,019)	64,940	63,921	$116.15	$7,424,386
Carbon Avoided (ton)	(642)	11,520	10,878	$129.73	$1,411,208
Net Savings ($):	-	-	-	-	**$8,453,930**

Avoided Runoff

Avoided runoff and water intercepted by trees within the different strata (excluding the Water category) in 2016.

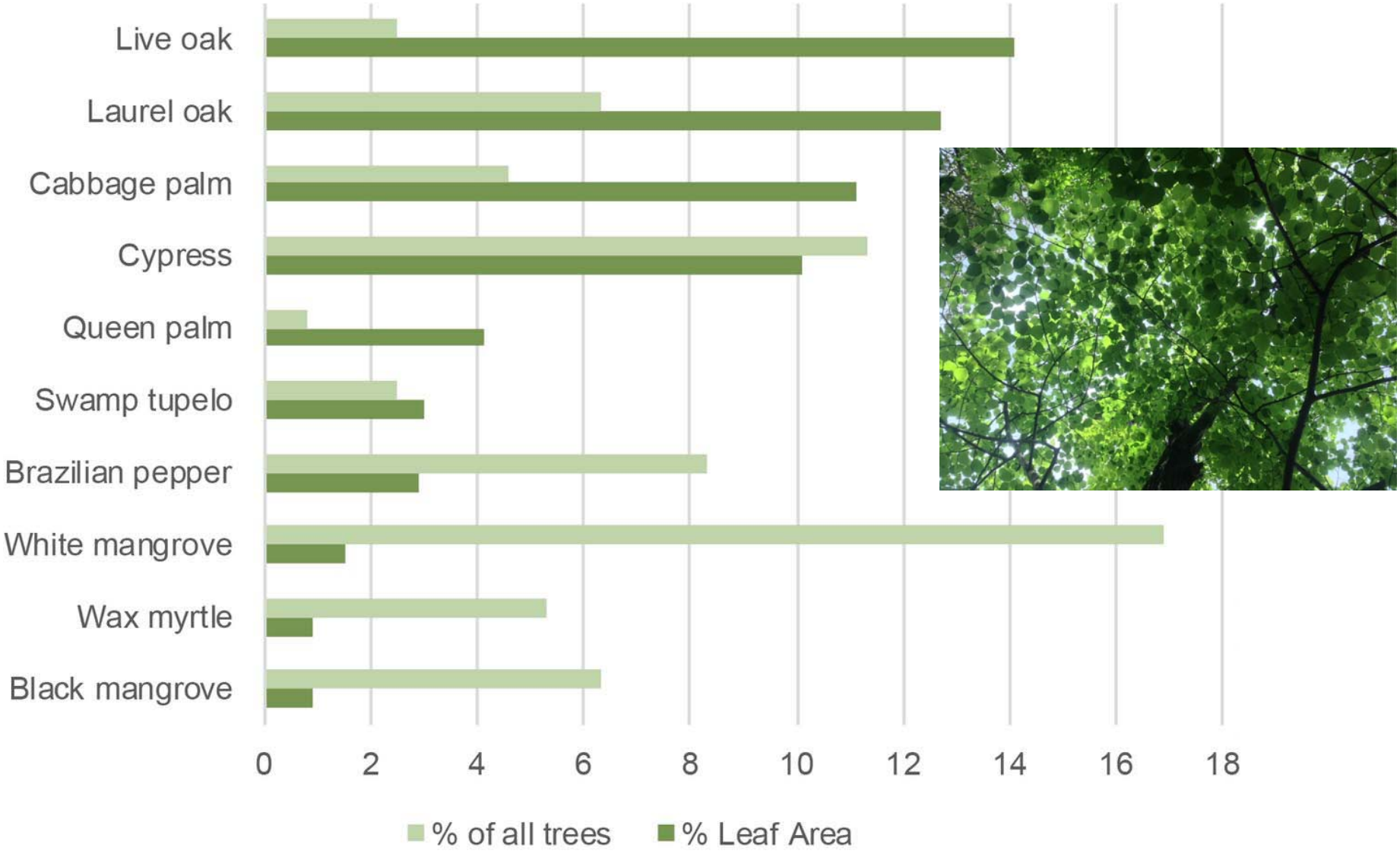
Strata	Water Intercepted (ft^3/yr)	Avoided Runoff (ft^3/yr)*	Avoided Runoff Value ($/yr)
Residential Single-Family	107,751,360.22	21,718,469.39	$1,451,789.46
Natural / Conservation Lands	38,724,177.84	7,805,283.10	$521,750.75
Right-of-Way / Transportion	26,183,084.50	5,277,488.08	$352,778.15
Commercial	22,978,930.13	4,631,655.60	$309,606.94
Parks / Recreation	11,686,900.47	2,355,623.07	$157,463.62
Residential Multi-Family	11,439,061.31	2,305,668.37	$154,124.35
Private Institutional	11,149,275.86	2,247,258.93	$150,219.92
Public Institutional	7,512,382.12	1,514,203.08	$101,218.19
Industrial	6,491,604.71	1,308,454.18	$87,464.73
Mangrove	5,646,258.79	1,138,065.43	$76,074.95
Public Communications Utility	224,568.19	45,264.18	$3,025.72
Agricultural	-	-	-
Study Area	249,787,604.14	50,347,433.42	$3,365,516.77

Summary: Ecosystem Services

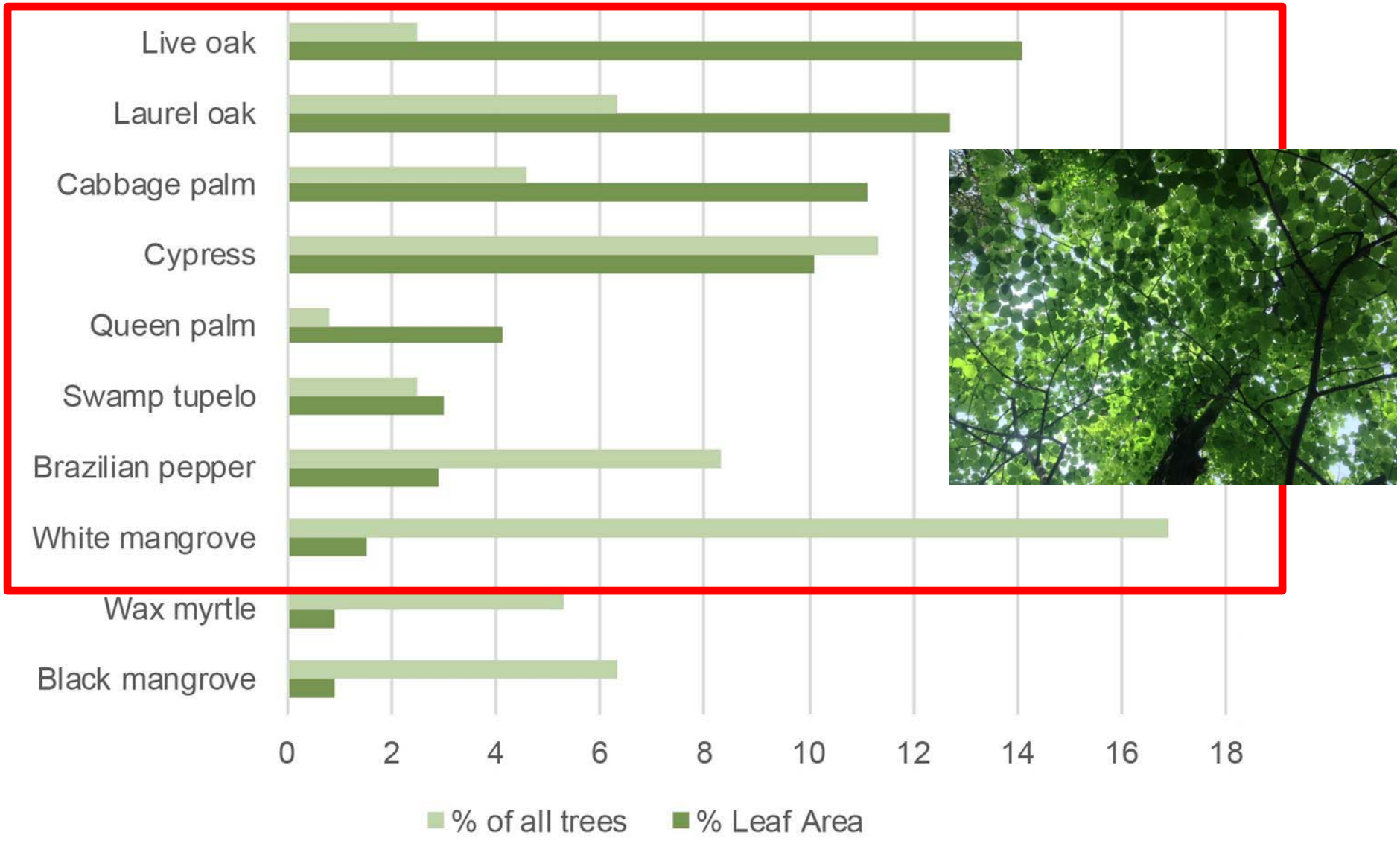
- Structural Value (i.e. Replacement Cost) - $2,014,785,011
- Energy Conservation - $8,453,930
- Air Pollution Mitigation and Associated Health Benefit - $9,103,424
- Carbon Sequestration and Storage (2016) - $119,870,000
- Avoided Runoff – $3,365,516

- **Total Value - $2.15 Billion**

Leaf Area – Species Abundance vs Species Contribution



Leaf Area – Species Abundance vs Species Contribution



Eight (8) species account for ~60% of Tampa's Canopy

State of Tampa's Urban Forest 2016

- Urban Forest Management Plan Introduction & Background
  - Robert Northrop
- I-Tree Inventory and Analysis
  - Dr. Andrew Koeser
- Spatial Analysis of Tree Canopy
  - Dr. Shawn Landry
- Urban Forest Ecosystems Services
  - Dr. Andrew Koeser
- Economic Value To Residential Property
  - Dr. Shawn Landry

How does a tree affect the sales price of a house?

- Hedonic Pricing Analysis: common statistical technique to estimate the market value of an amenity/asset
- Estimates the value of a tree by accounting for all other characteristics that impact the market price of a house (square footage, # bedrooms, etc.)

Contents lists available at ScienceDirect

Landscape and Urban Planning

journal homepage: www.elsevier.com/locate/landurbplan

Trees in the city: Valuing street trees in Portland, Oregon

Geoffrey H. Donovan[a,*], David T. Butry[b]

[a] Pacific Northwest Research Station, Portland Forestry Sciences Laboratory, P.O. Box 3890, Portland, OR 97208, United States

Contents lists available at ScienceDirect

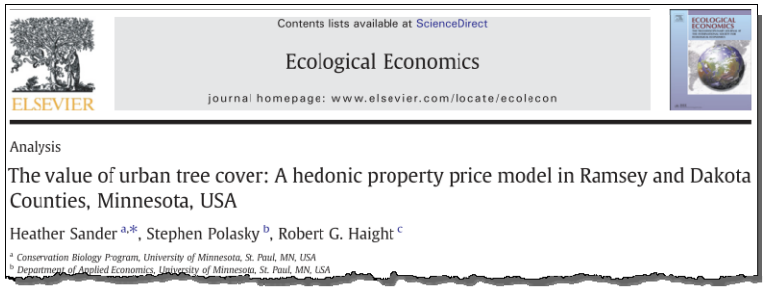
Urban Forestry & Urban Greening

journal homepage: www.elsevier.de/ufug

The effect of urban trees on the rental price of single-family homes in Portland, Oregon

Geoffrey H. Donovan[a,*], David T. Butry[b,1]

[a] USDA Forest Service, PNW Research Station, 620 SW Main, Suite 400, Portland, OR 97205, United States



Contents lists available at ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon

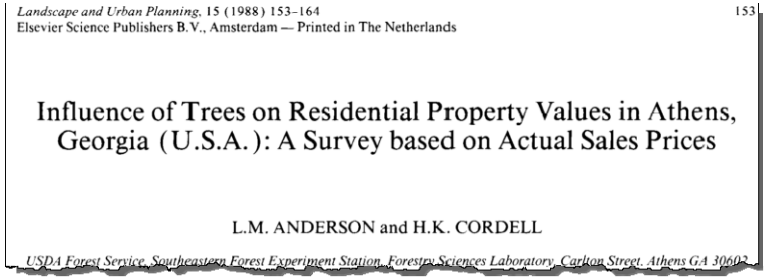
Analysis

The value of urban tree cover: A hedonic property price model in Ramsey and Dakota Counties, Minnesota, USA

Heather Sander[a,*], Stephen Polasky[b], Robert G. Haight[c]

[a] Conservation Biology Program, University of Minnesota, St. Paul, MN, USA

[b] Department of Applied Economics, University of Minnesota, St. Paul, MN, USA



Landscape and Urban Planning, 15 (1988) 153–164

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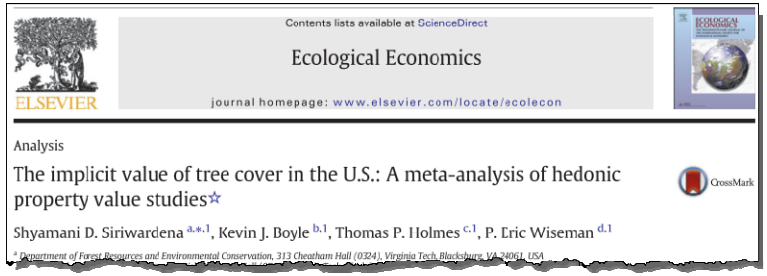
Influence of Trees on Residential Property Values in Athens, Georgia (U.S.A.): A Survey based on Actual Sales Prices

L.M. ANDERSON and H.K. CORDELL

USDA Forest Service, Southeastern Forest Experiment Station, Forestry Sciences Laboratory, Carlton Street, Athens GA 30602



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Analysis

The implicit value of tree cover in the U.S.: A meta-analysis of hedonic property value studies☆

Shyamani D. Siriwardena[a,*,1], Kevin J. Boyle[b,1], Thomas P. Holmes[c,1], P. Eric Wiseman[d,1]

[a] Department of Forest Resources and Environmental Conservation, 313 Cheatham Hall (0324), Virginia Tech, Blacksburg, VA 24061, USA

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Urban Forestry & Urban Greening

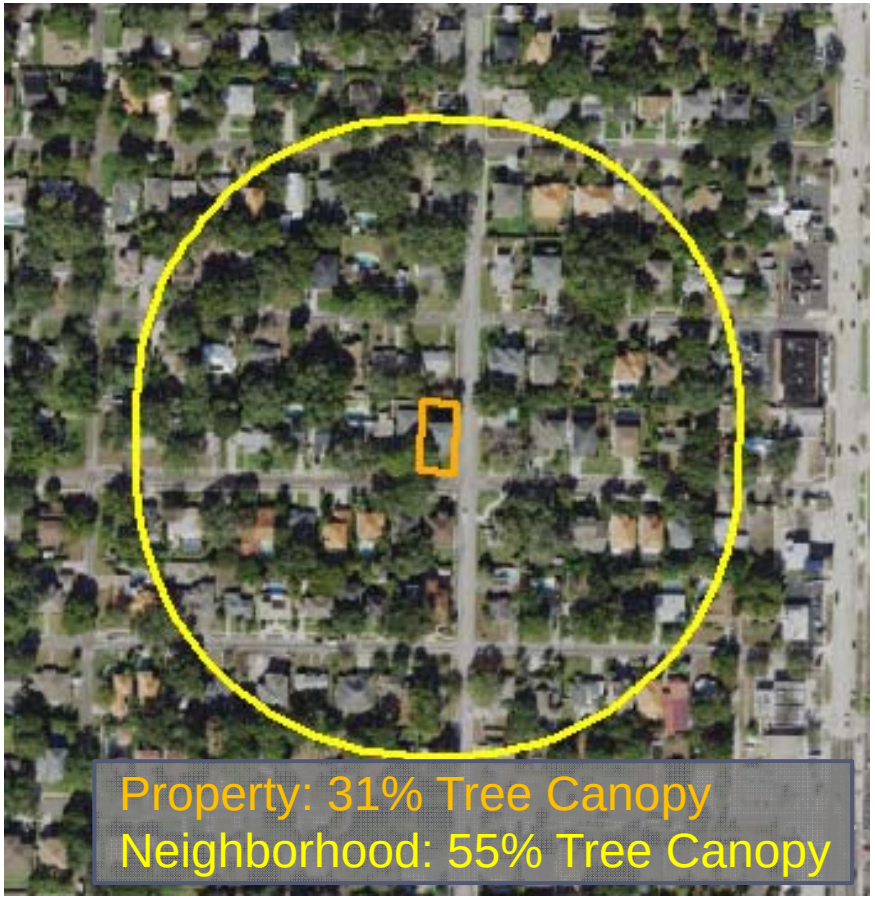
journal homepage: www.elsevier.com/locate/ufug

Assessing amenity effects of urban landscapes on housing price in Hangzhou, China

Haizhen Wen[a,b], Yan Zhang[a,b], Ling Zhang[a,b,*]

Estimating the Value of Trees for SF Home in Tampa

- Partnered with Dr. Geoffrey Donovan, economist with the US Forest Service
- Analysis included all single-family homes that sold between May 2015 – May 2016
  - Property data provided by Hillsborough County Property Appraisers Office, Computer-Assisted Mass Appraisal database
  - Excluded new construction
  - 4,848 property parcels included in analysis
- Two tree canopy variables examined:
  - Tree canopy associated with trees originating within the property boundary
  - All tree canopy within 500 foot around the property ~ 60 homes
- Property attributes
  - location factors - neighborhood (HCPA)
  - number of bedrooms, baths and number of stories; house square feet and parcel acreage; year built; presence of garage, carport, porch or pool; architectural style; roof type; type of air conditioning; and whether the home was on waterfront property.



A Robust Statistical Analysis

statistical models

1) A linear mixed model that included a random effect for a house's neighborhood (*MIXED*);
2) A spatial error model that allowed for spatial correlation among error terms (*ERROR*);
3) A spatial lag model that allowed for spatial correlation among sales prices (*LAG*);
4) A joint lag and error model that allowed for spatial correlation among both sales prices and error terms (*LAG AND ERROR*).

	MIXED	*ERROR*	*LAG*	*LAG AND ERROR*
VARIABLES	Coefficient	Coefficient	Coefficient	Coefficient
Number of Bedrooms	0.0492***	0.0541***	0.0540***	0.0523***
Number of Bathrooms	0.0616***	0.0569***	0.0584***	0.0587***
Heated Area (sq. ft)	0.000291***	0.000282***	0.000277***	0.000275***
Number of Stories	-0.0627*	-0.0657**	-0.0622*	-0.0616*
Property Acreage	0.420***	0.440***	0.440***	0.444***
Year Built (Actual)	0.00647***	0.00674***	0.00671***	0.00671***
Garage (0=No/1=Yes)	0.150***	0.143***	0.140***	0.142***
Carport (0=No/1=Yes)	0.0659***	0.0624***	0.0615***	0.0632***
Open Front Porch (0=No/1=Yes)	0.0681***	0.0659***	0.0643***	0.0638***
Pool (0=No/1=Yes)	0.0933***	0.0892***	0.0867***	0.0873***
Waterfront Property (0=No/1=Yes)	0.422***	0.438***	0.446***	0.447***
Tree Canopy in Neighborhood (%)	**0.0936***	**0.0965****	**0.0962****	**0.0993****
ARCHITECTURE STYLE (Omitted: basic 1 story)				
Basic Multi-Story	-0.0156	-0.0048	-0.00925	-0.00788
Contemporary 1-Story	0.00936	0.00419	0.0059	0.0114
Contemporary Multi-Story	-0.0708	-0.0732	-0.0812*	-0.0769
Mansion	-1.478***	-1.406***	-1.402***	-1.382***
Pre-1940 1-Story	0.0928**	0.0985***	0.0919**	0.0930**
Pre-1940 Multi-Story	0.279***	0.279***	0.269***	0.276***
Unique Design	-0.514	-0.528	-0.503	-0.512
Updated Basic 1-Story	0.216***	0.215***	0.212***	0.213***
Updated Basic Multi-Story	0.182**	0.176**	0.169**	0.170**
Updated Contemporary 1-Story	0.300**	0.298**	0.284**	0.274**
Updated Contemporary Multi-Story	0.044	0.0332	0.0391	0.0557
Updated Pre-1940 1-Story	0.532***	0.539***	0.526***	0.531***
Updated Pre-1940 Multi-Story	0.661***	0.667***	0.660***	0.668***
Updated Unique Design	0.326	0.33	0.313	0.318
AC TYPE (Omitted: central)				
Non-ducted (i.e., window)	-0.282***	-0.267***	-0.266***	-0.267***
No AC	-0.628***	-0.629***	-0.623***	-0.626***
ROOF TYPE Dummy Variables	a	a	a	a
NEIGHBORHOOD Dummy Variables		b	b	b
SPATIAL REGRESSION VARIABLES				
lambda		-1.812***		-0.730**
rho			0.448***	0.504***

[a] Statistically significant coefficients for Roof Type dummy variables range from 0.292 to 0.398 compared to an asbestos roof.

[b] Statistically significant coefficients for Neighborhood dummy variables range from -1.535 to 1.051 compared to the arbitrarily chosen Port Tampa neighborhood.

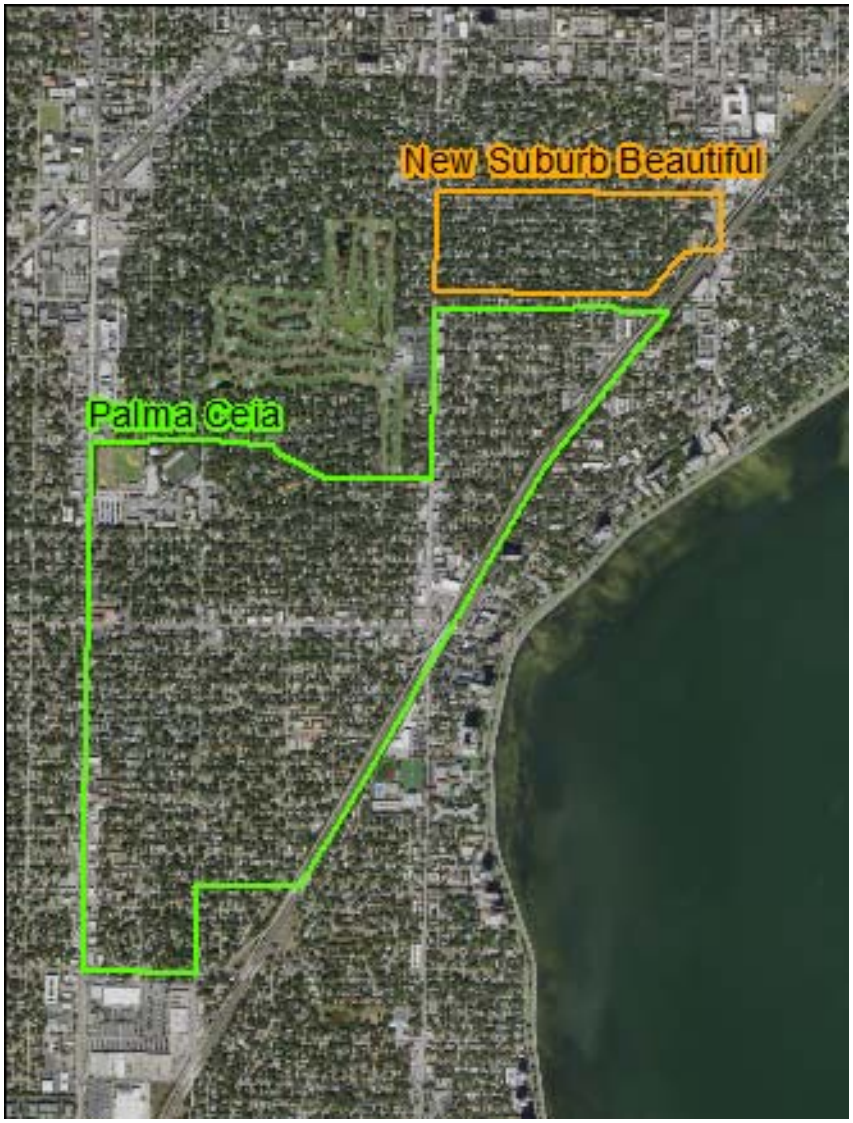
Value of Trees for Single-Family Home Sales in Tampa

- Tree canopy in the 500' neighborhood surrounding a home is more valuable than the trees on the individual single-family property.
- A 1% increase in tree canopy cover in the 500' neighborhood adds $155 to $164 to the sales price of every single-family home.
  - An increase of 10% adds $1,550
- Based on an average of 60 homes within the buffer, an increase of 1% canopy is worth $9,271 to the combined sales in a neighborhood
  - An increase of 10% adds $92,710

Based on the average canopy size per tree measured from the field plots in Tampa:

- One average sized tree adds $1,378 to the combined sales in a 500' neighborhood
- One mature oak tree adds $2,028 to the combined sales in a 500' neighborhood

Comparison of Two Neighborhoods



- New Suburb Beautiful
  - 58% Tree Canopy
  - Trees add @ $8,900 to sales prices of each home
- Palma Ceia
  - 40% Tree Canopy
  - Trees add @ $6,100 to the sales price of each home

Questions?