Greening the Gateway Cities

Human-Environment Regional Observatory (HERO)

July 13th 2017

Eli Baldwin, Meyru Bhanti, Hannah Corney, Joe Mogel, Miles Weule & Gemma Wilkens

Our Research Team

Clark University

Eli Baldwin, Meyru Bhanti, Hannah Corney, Joe Mogel, Miles Weule & Gemma Wilkens

Zhiwen Zhu, Mark Healey & Arthur Elmes

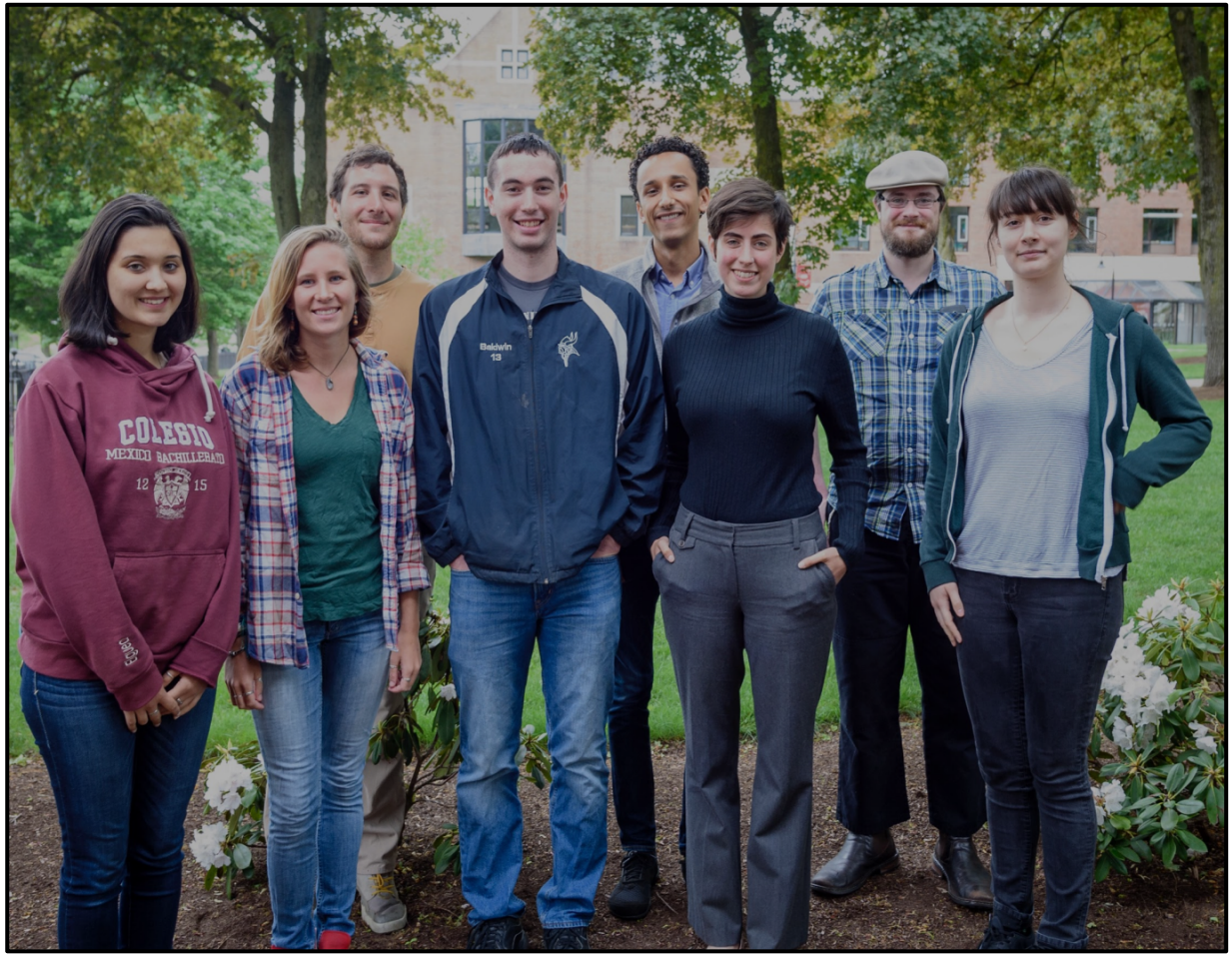
John Rogan & Deb Martin

University of Massachusetts Amherst

Madison Kremer

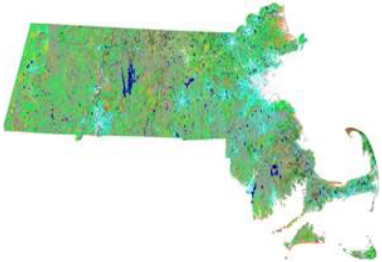
Ben Breger

Theodore Eisenman



Front Row: Meyru, Hannah, Eli, Sonny & Gemma
Back Row: Ben, Miles & Joe

Undergraduate Human-Environment Research



1999

2005

2012

GREENING THE GATEWAY CITIES

2017

HERO Human-Environment Regional Observatory

Greening the Gateway Cities (GGC) Program

Goal: To reduce energy costs by expanding tree canopy to cover 10% of the gateway cities.

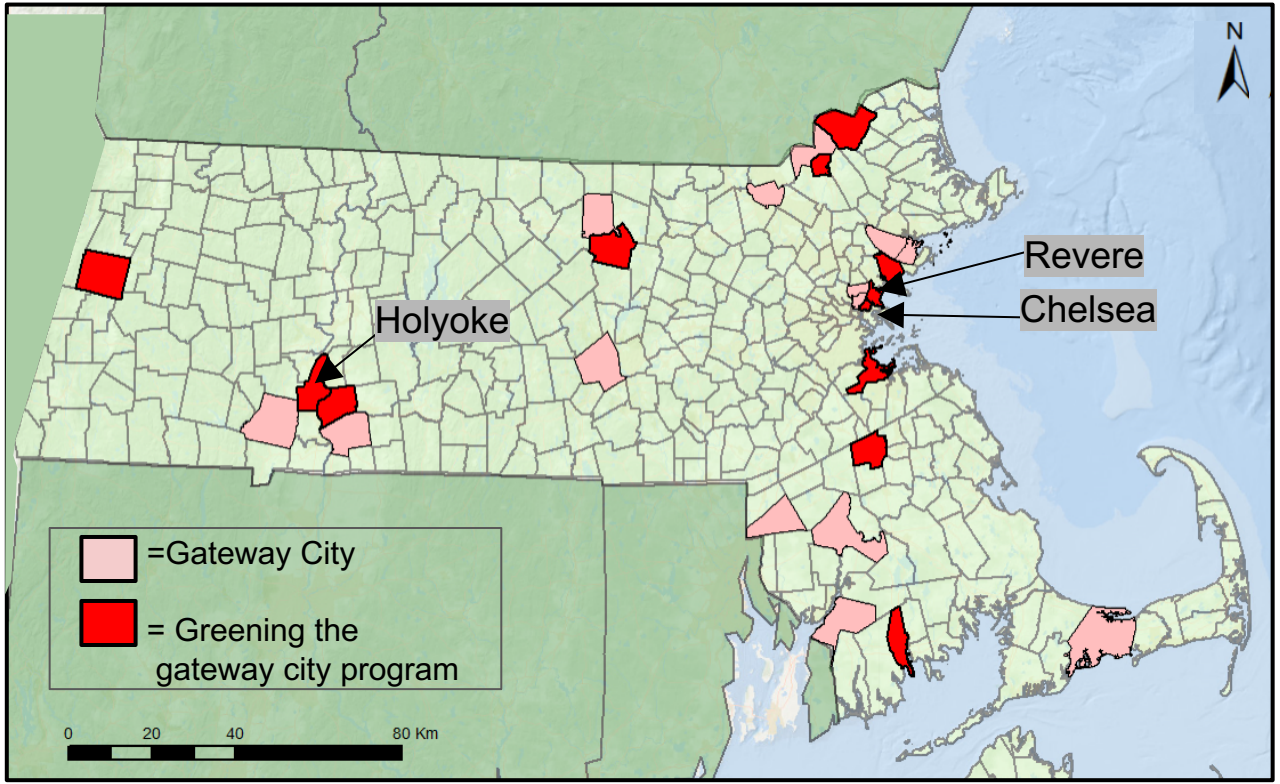
Planting zone criteria:

Low tree canopy

Older housing stock

High wind speeds

Large renter population



Why Plant Trees?

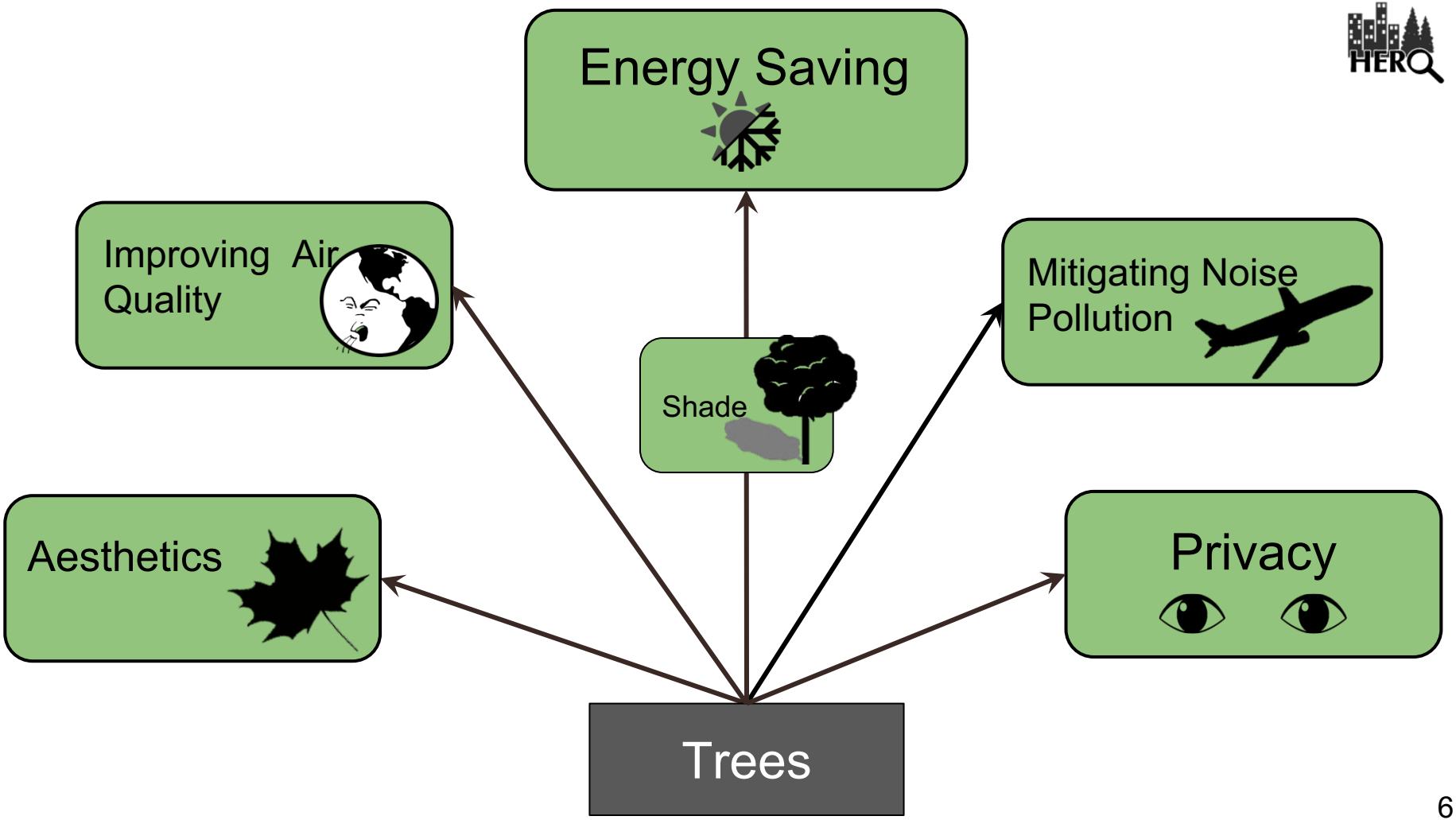
Urban Heat Islands: Metropolitan areas in which the temperature is significantly higher than surrounding vegetated areas due to human activities

Temperature 20-50°F higher in urban heat islands.

For every 1°F of increase over 68°F energy demands increase by up to 2%

Increase peak demand

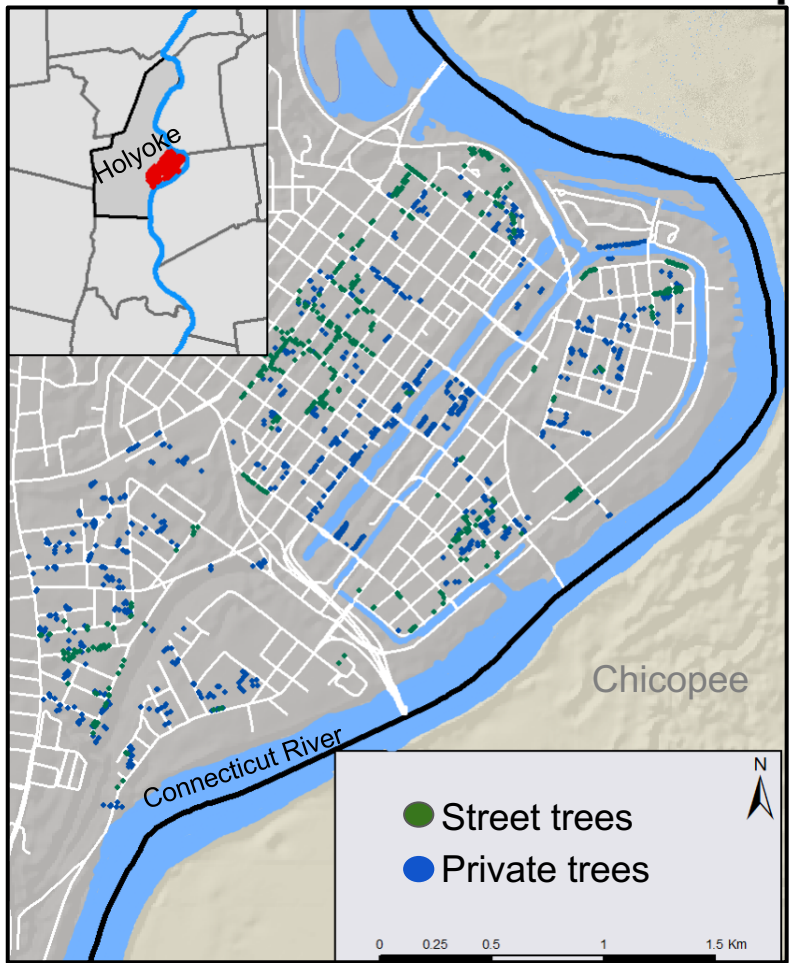
http://www.wbur.org/commonhealth/2017/07/05/greater-boston-heat-islands


Energy Saving
Improving Air Quality
Mitigating Noise Pollution
Shade
Aesthetics
Privacy
Trees

Holyoke (Fall 2014-Present)

Population: 40,280
Median Household Income: $37,372
Education: 23.4%

842 trees surveyed
- 515 street trees
- 327 private trees



Chelsea (Spring 2014-Present)

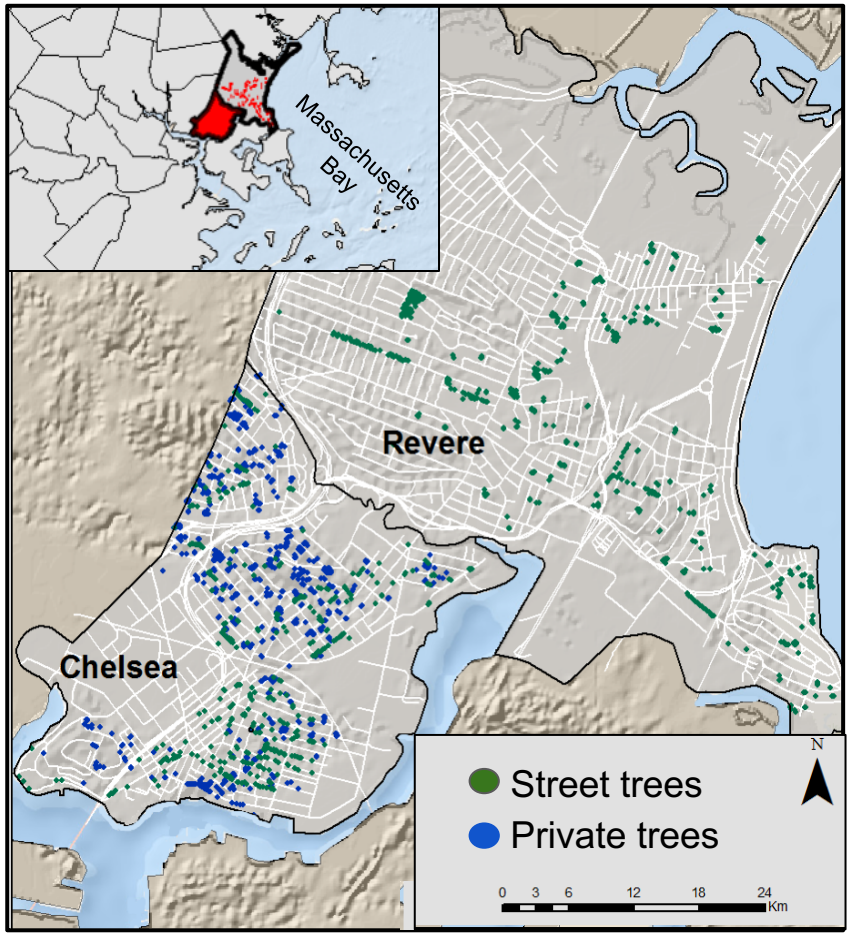
Population: 38,861
Median Household Income: $49,231
Education: 65.4%

429 trees surveyed
373 street trees
56 private trees

Revere (Fall 2015-Present)

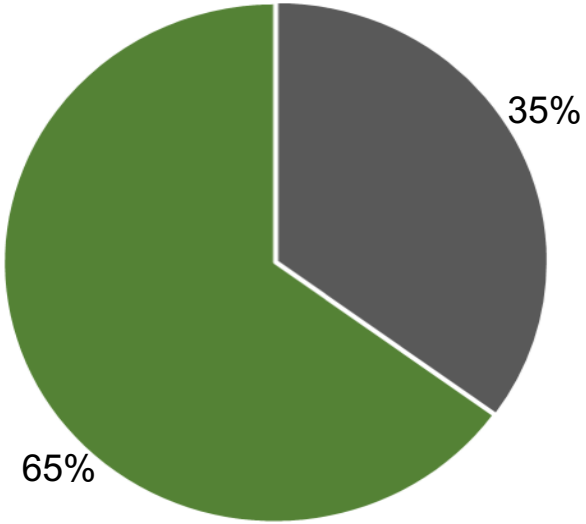
Population: 54,157
Median Household Income: $52,483
Education: 19.5%

117 trees surveyed
117 street trees
0 private trees



Impervious Surface Composition

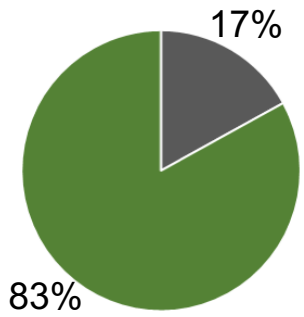
Average for all Greening the Gateway Cities (12 cities)
Area 56.3 km²



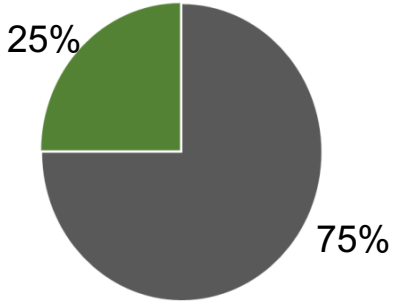
Impervious

Non-impervious

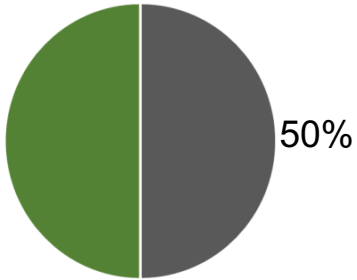
Holyoke
Area 59.1 km²



Chelsea
Area 6.4 km²



Revere
Area 26 km²



Research Questions

1. **Understand factors related to tree health and survivorship**

   How does tree health compare across the three cities?

   …by species?

   …by land use?

   …by site type?

2. **Understand the contribution and experience of residents and stakeholders**

   What attitudes contribute to successful tree stewardship?

   What are the experiences of residence in caring for trees?

   How have the new trees affected residents' perception of their property? of their neighborhood? of their city?

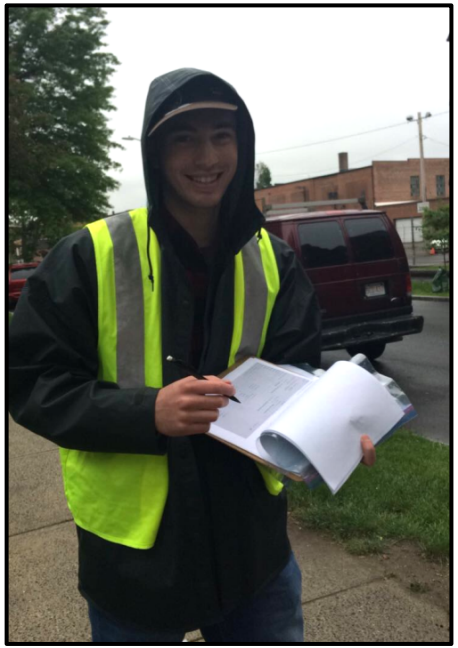
Tree Survey and Interviews

Tree Survey - 4 weeks

Assess tree characteristics that indicate tree health and canopy cover

Record environmental factors that could affect tree health

Interviews - 1 week



Interview residents and stakeholders

Assess resident interaction with the Department of Conservation and Recreation

Tree Assessment Characteristics: Survivorship

Alive

Standing Dead

Removed

0		U	
0		U	
0		U	
3	26-Apr-16	U	N
2.125	26-Apr-16	U	N
70833333		U	
4.625	26-Apr-16	U	N
0		U	
0	11/12/2014	U	
0	28-Apr-16	U	N
0		U	N
0	01-Jun-16	U	N

Unknown

Tree Assessment Characteristics: Vigor

1 - Healthy

2 - Slightly unhealthy

3 - Moderately unhealthy

4 - Severely unhealthy

5 - Dead

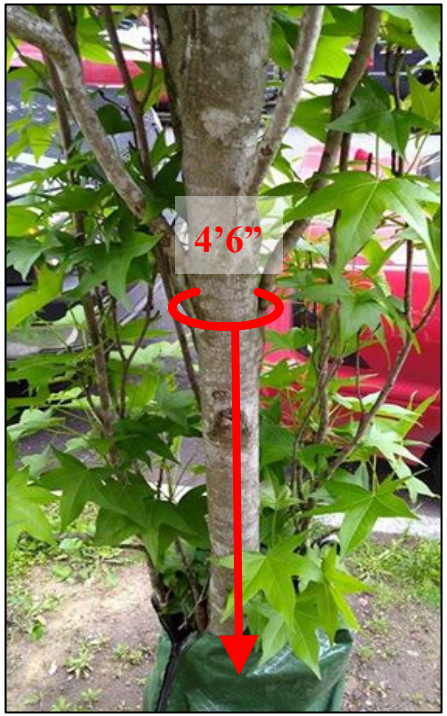
Tree Health: Other Indicators

Basal Sprouting

Insect & Fungus Damage

Trunk Damage

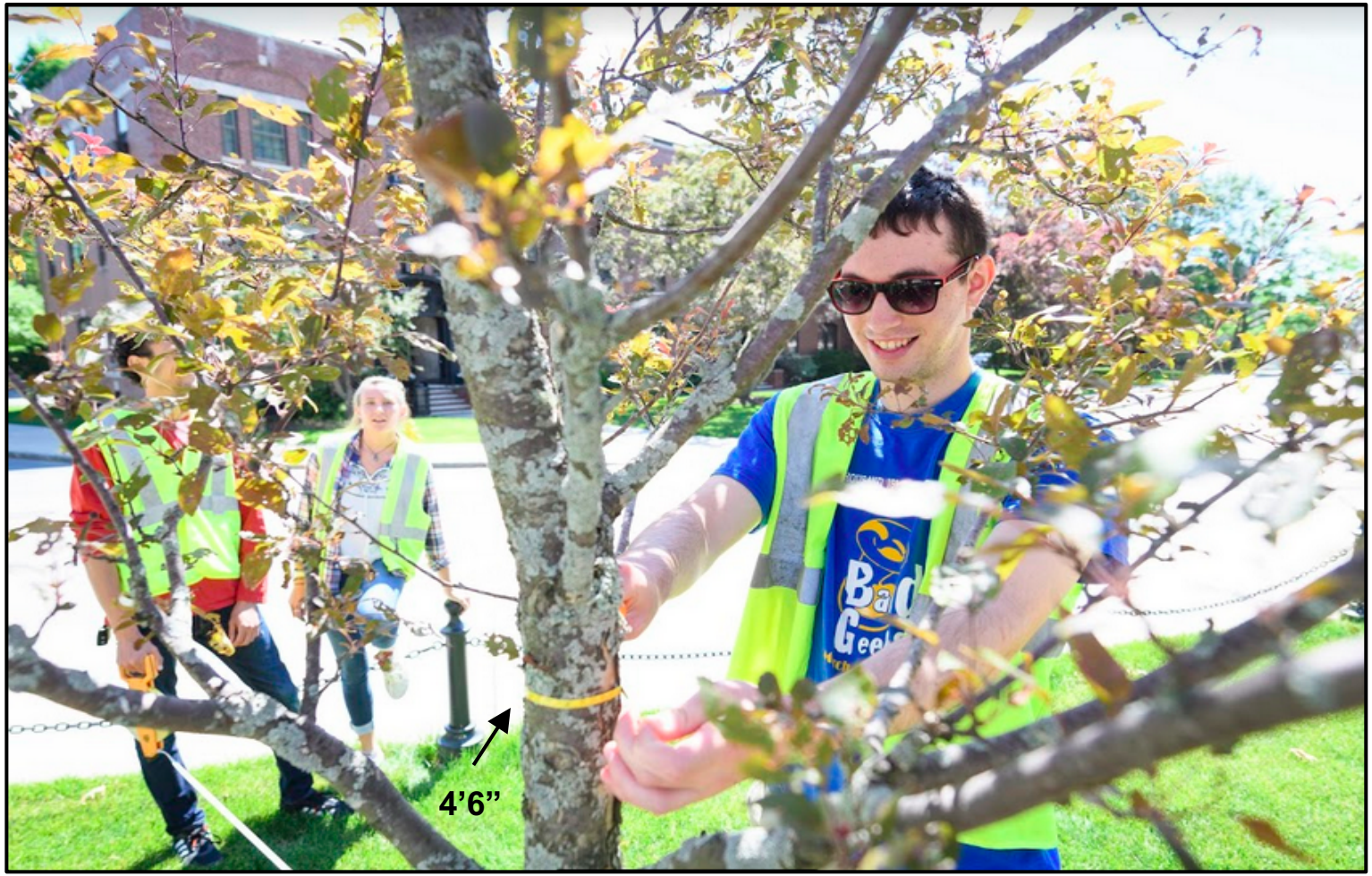
Tree Assessment Characteristics: Size Metrics



Diameter at Breast Height (DBH)

Height and Canopy Width

Distance to Impervious



HERO Eli measuring **DBH**

HERO's Meyru, Miles and Hannah measuring **height**

HERO's Gemma, Eli and Miles measuring **width**

HERO’s Hannah and Miles measuring distance to impervious

Tree Assessment Characteristics: Site Type

Planting Strip

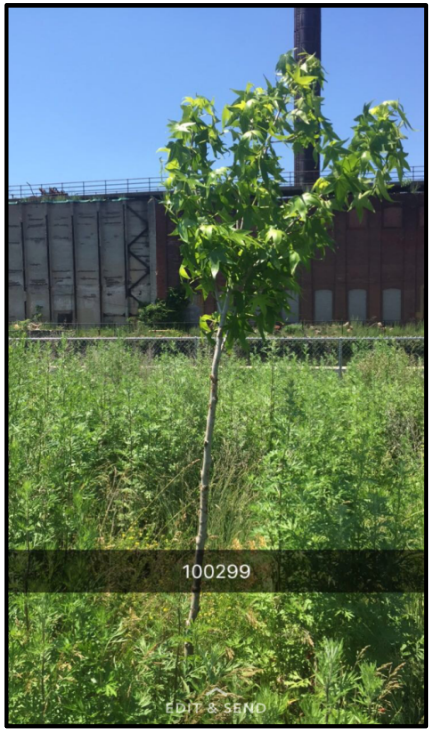
Sidewalk Cutout

Maintained Park

Other Maintained

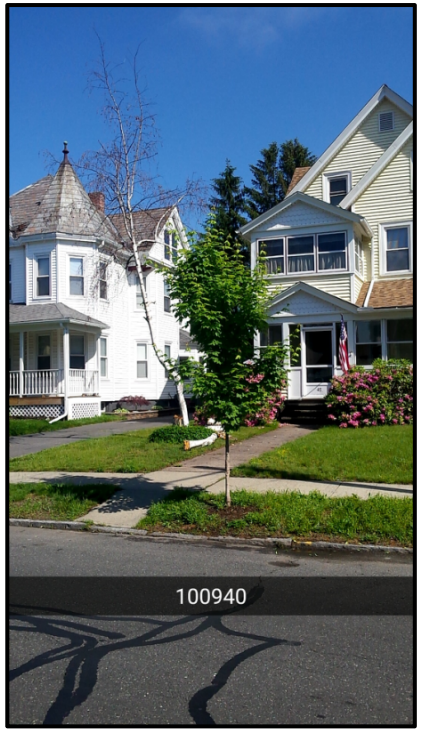
Tree Assessment Characteristics: Area Land Use

Commercial land use



Industrial land use

Multi-family residential



Single-family residential

Name: GW

Name: HC

TreeID: 100713

Date Planted: 10/8/2014

Resident Name: John Dow

Address: 25 Nowhere St.

City: Holyoke

Name: MB

Experience Level: N I E

Speies: Oxydendrum arboreum

Resient Tel: 999-999-9999

Comments: Insect damage on 25% of leaves

Date Measured: 6/20/2017

Site Type: Sidewalk Cutout

Land Use: Multi-family Residential

Mortality: (A) SD R S U

Basal Sprouts:

DBH1:	2.4	@ height: 4'6"	DBH4:		@ height:
DBH2:		@ height:	DBH5:		@ height:
DBH3:		@ height:	DBH6:		@ height:

Height: 15 ft 6 in

Width 1: 5 ft 2 in Width 2: 6 ft 3

Vigor Class: 1 (2) 3 4 5

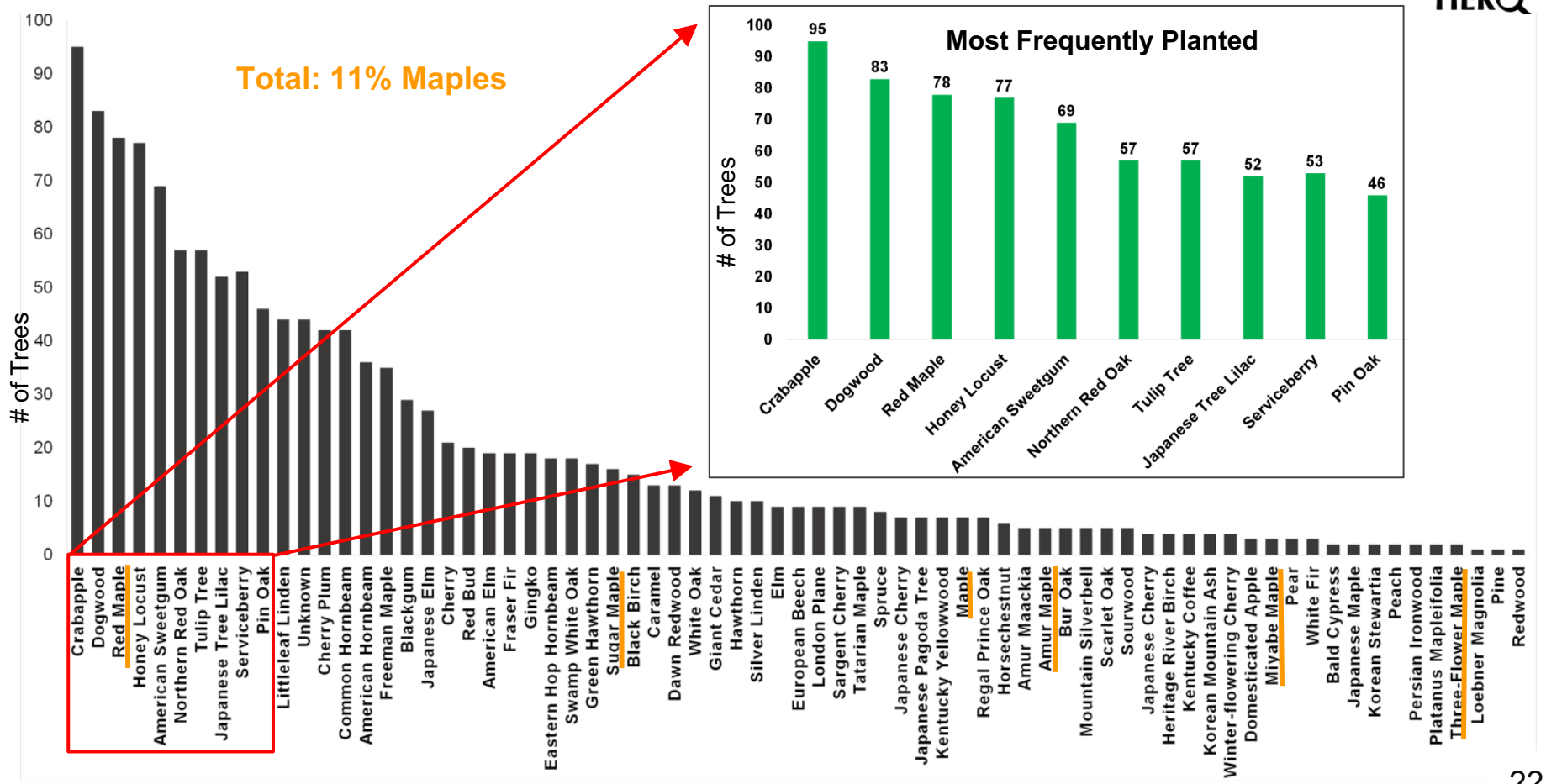
Dist. to impervious 1: 2 ft 5 i

Time to Measure (min):

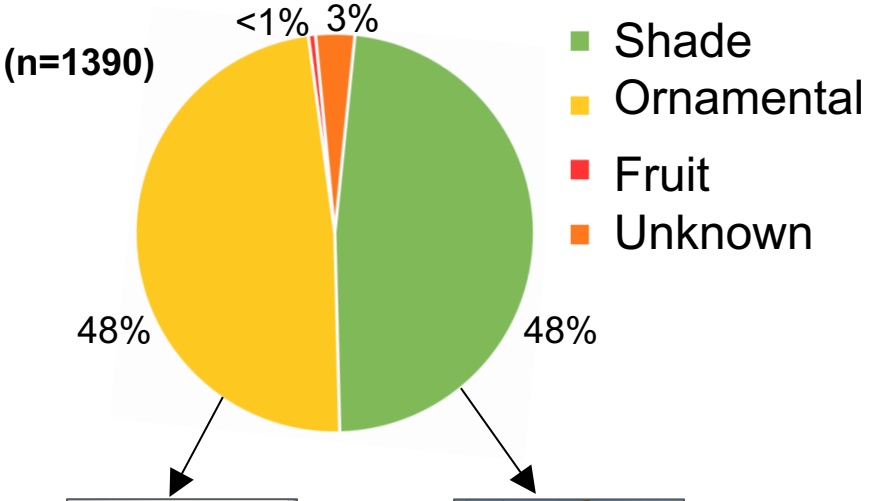
Dist. to impervious 2: 3 ft 2 i

Notes for Supervisory Review:

Species Composition of All Trees (n=1390)

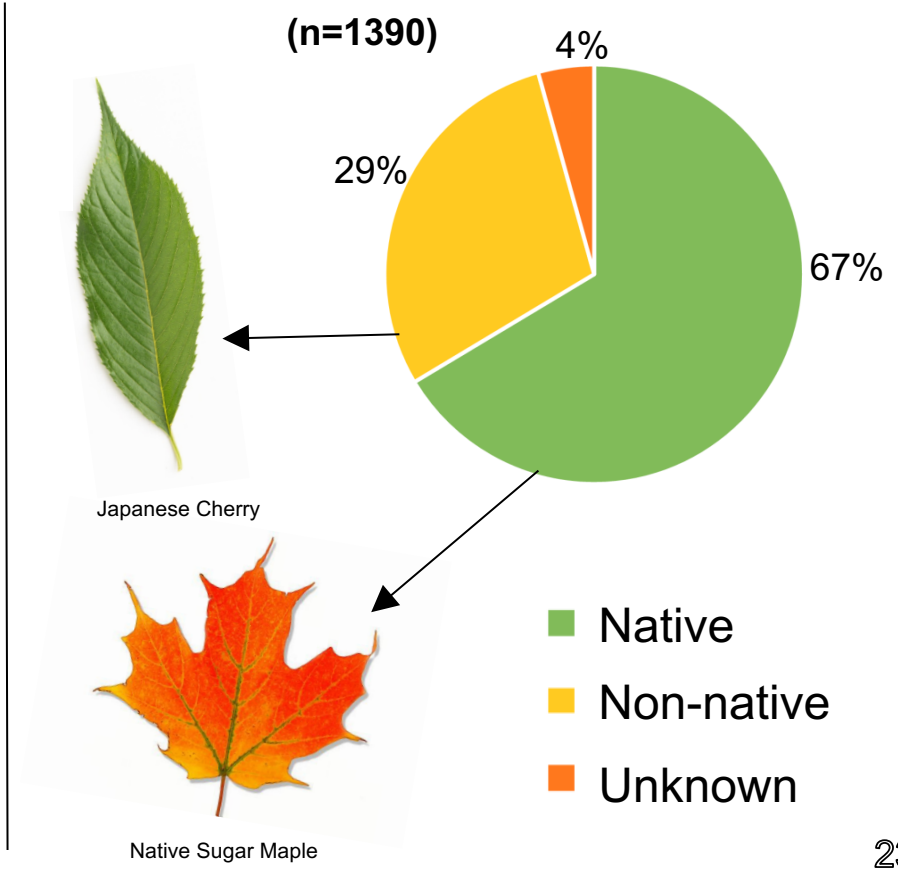


Species Attribute Composition of All Trees



Fraser Fir

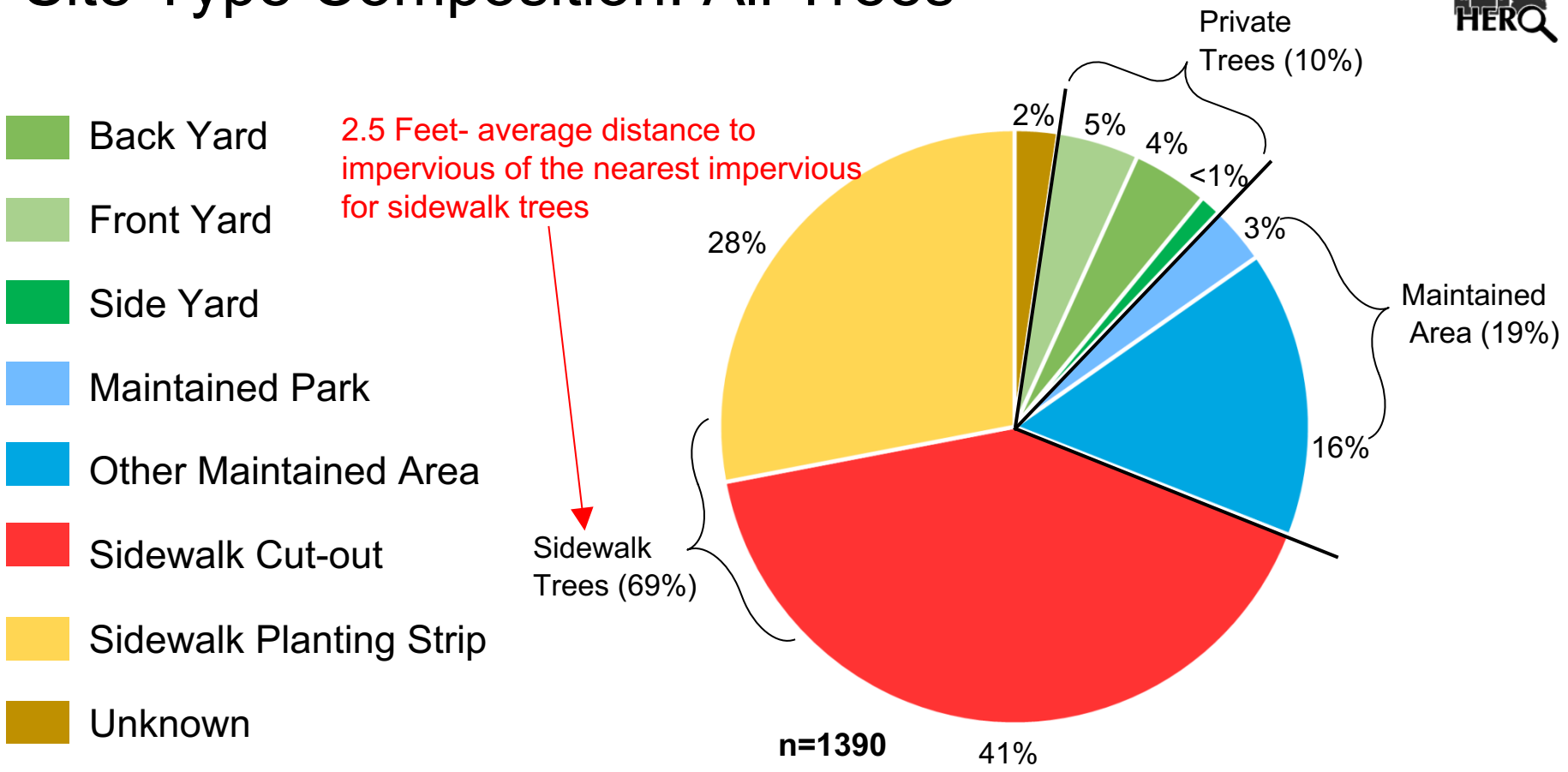
Maple



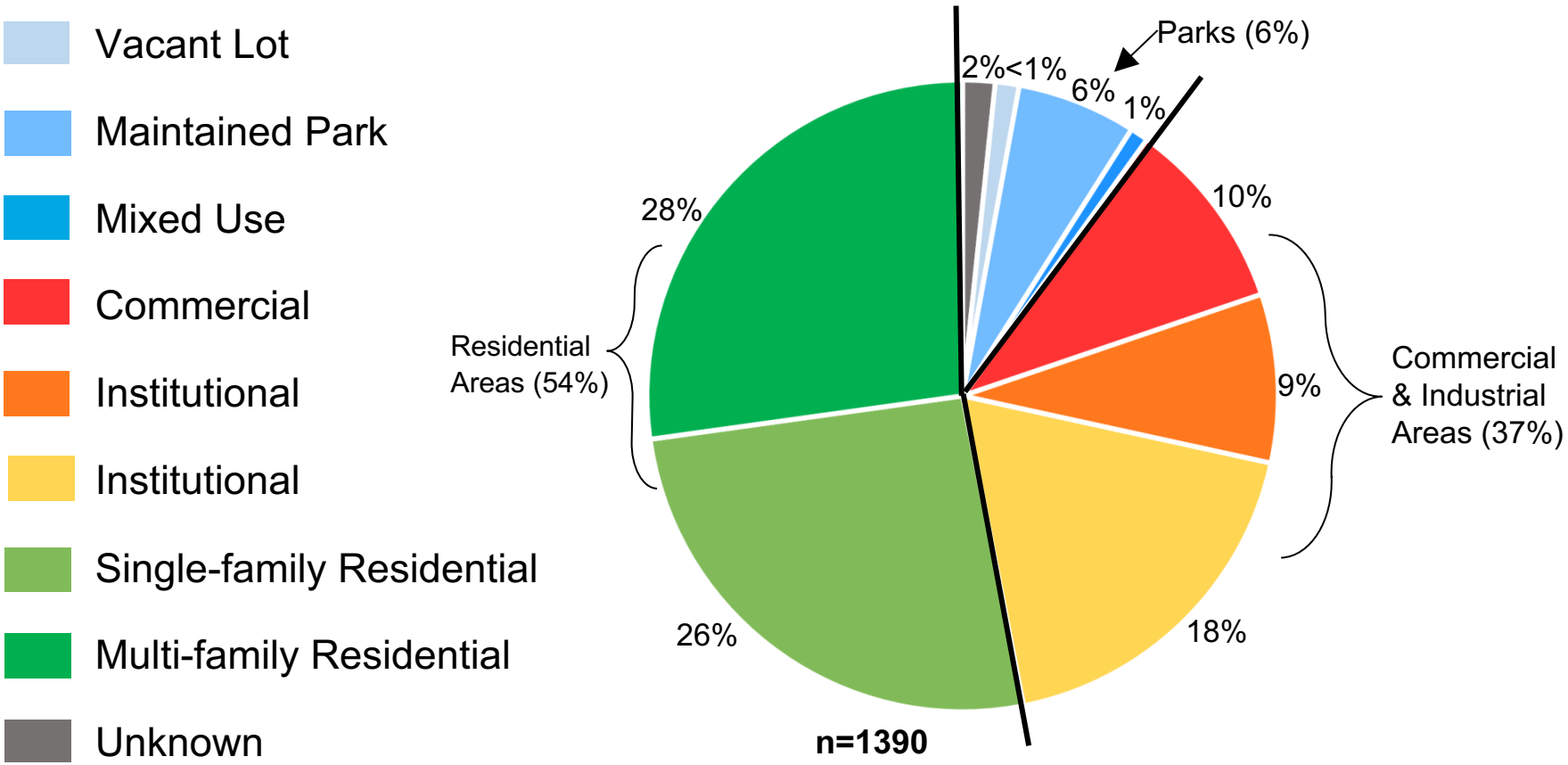
Japanese Cherry

Native Sugar Maple

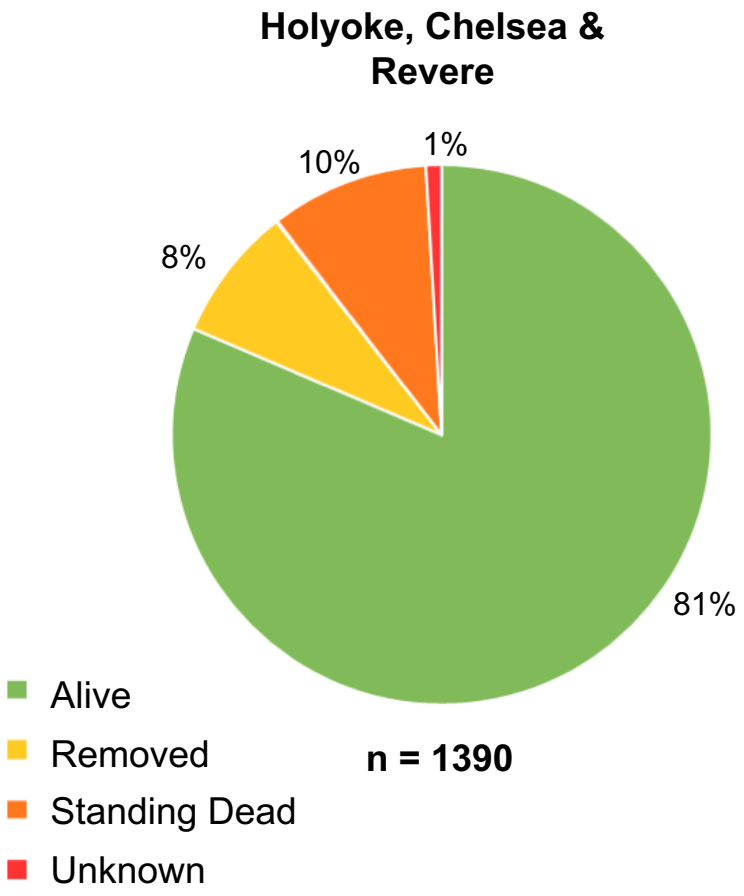
Site Type Composition: All Trees

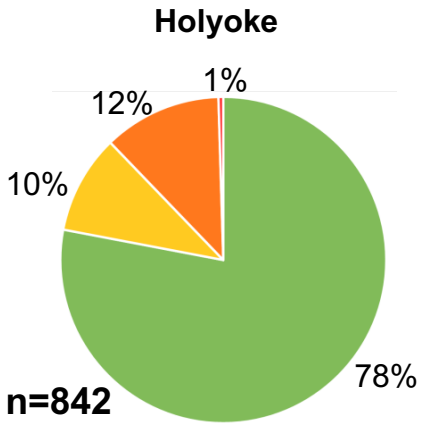


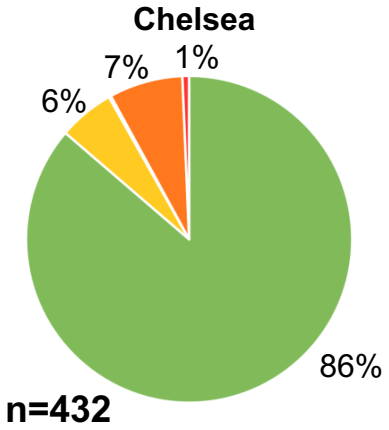
Land Use Composition: All Trees

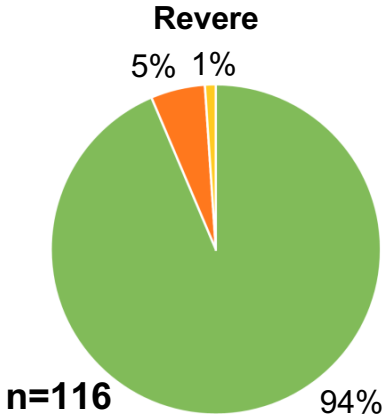


Survivorship: All Trees





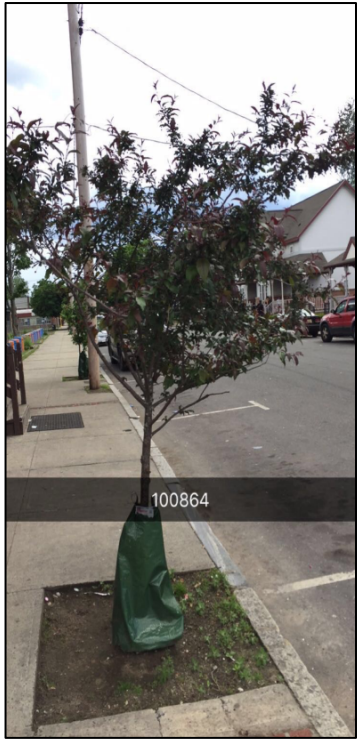




Top Five Species for Survivorship

Cherry Plum

Eastern Redbud

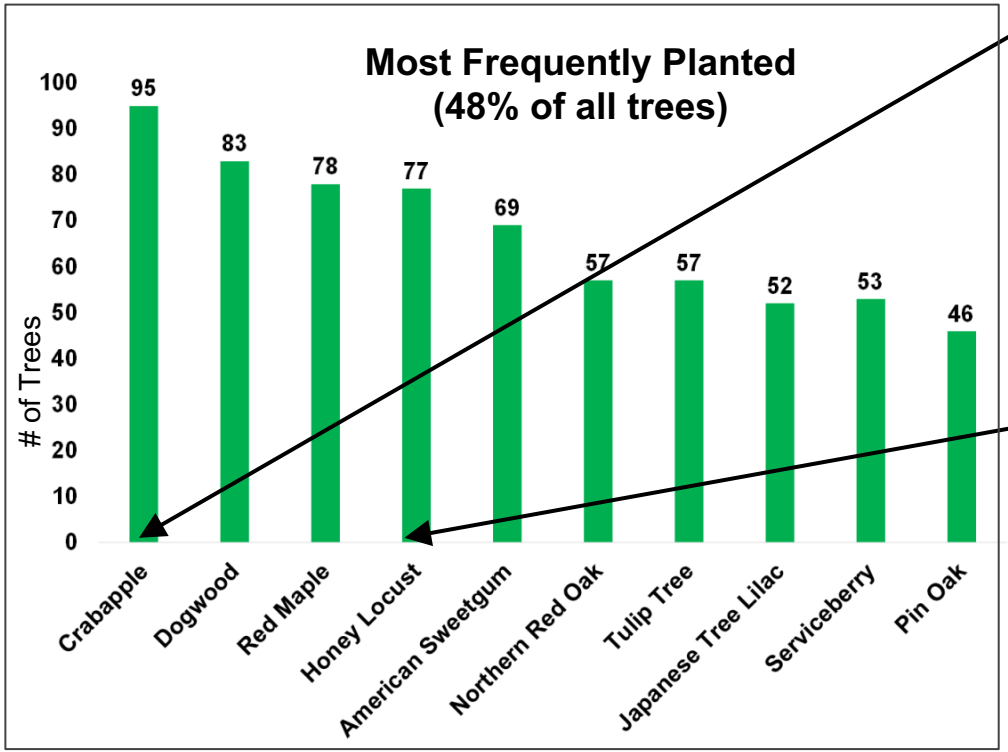


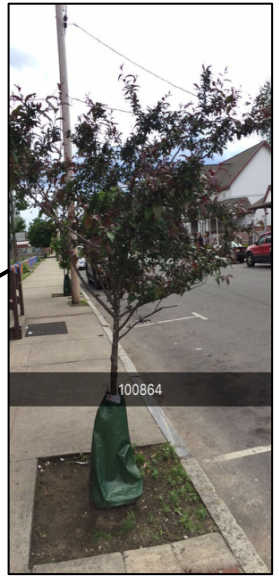
Crabapple

White Oak

Honey locust

Species Composition of All Trees





Crabapple

Honey Locust

Bottom Five Species For Survivorship

Black Gum

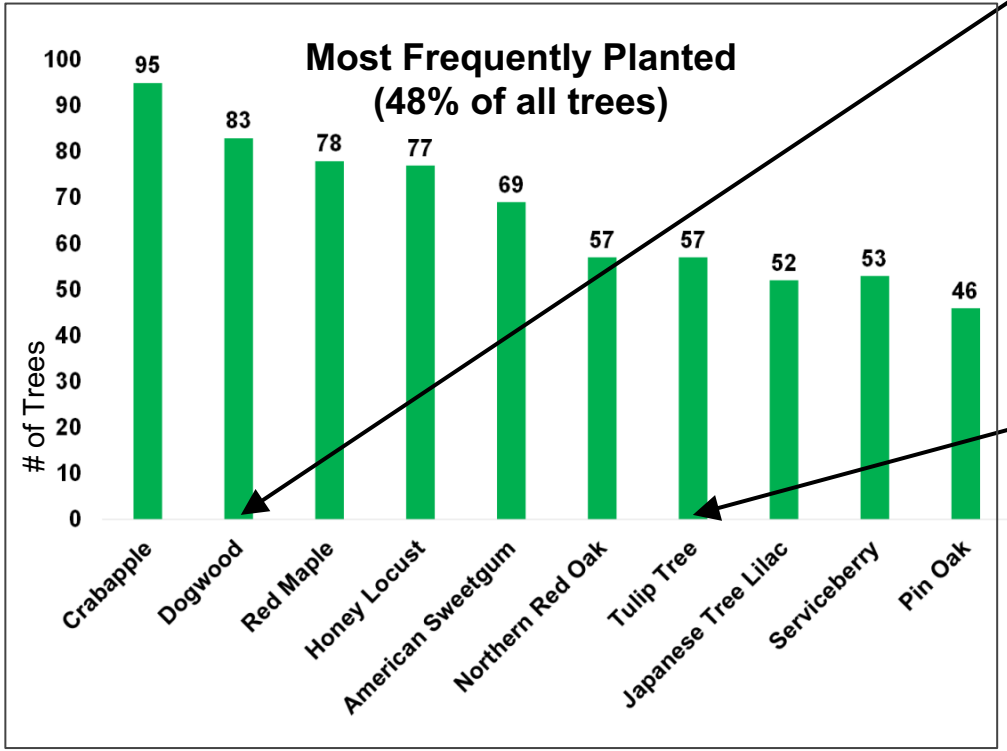
Tulip Tree

Dawn Redwood

Cherry Dogwood

Dogwood

Species Composition of All Trees



Dogwood

Tulip Tree

Street Trees

Census of tree health
Nearly all street trees were surveyed based on DCR geodatabase

Stewardship responsibility
Maintained by the DCR and/or Department of Public Works

Size
Generally a larger caliper stem at planting (2.0-2.5 in)

Stresses
Include traffic,vandalism & lower quality soil

Private Trees

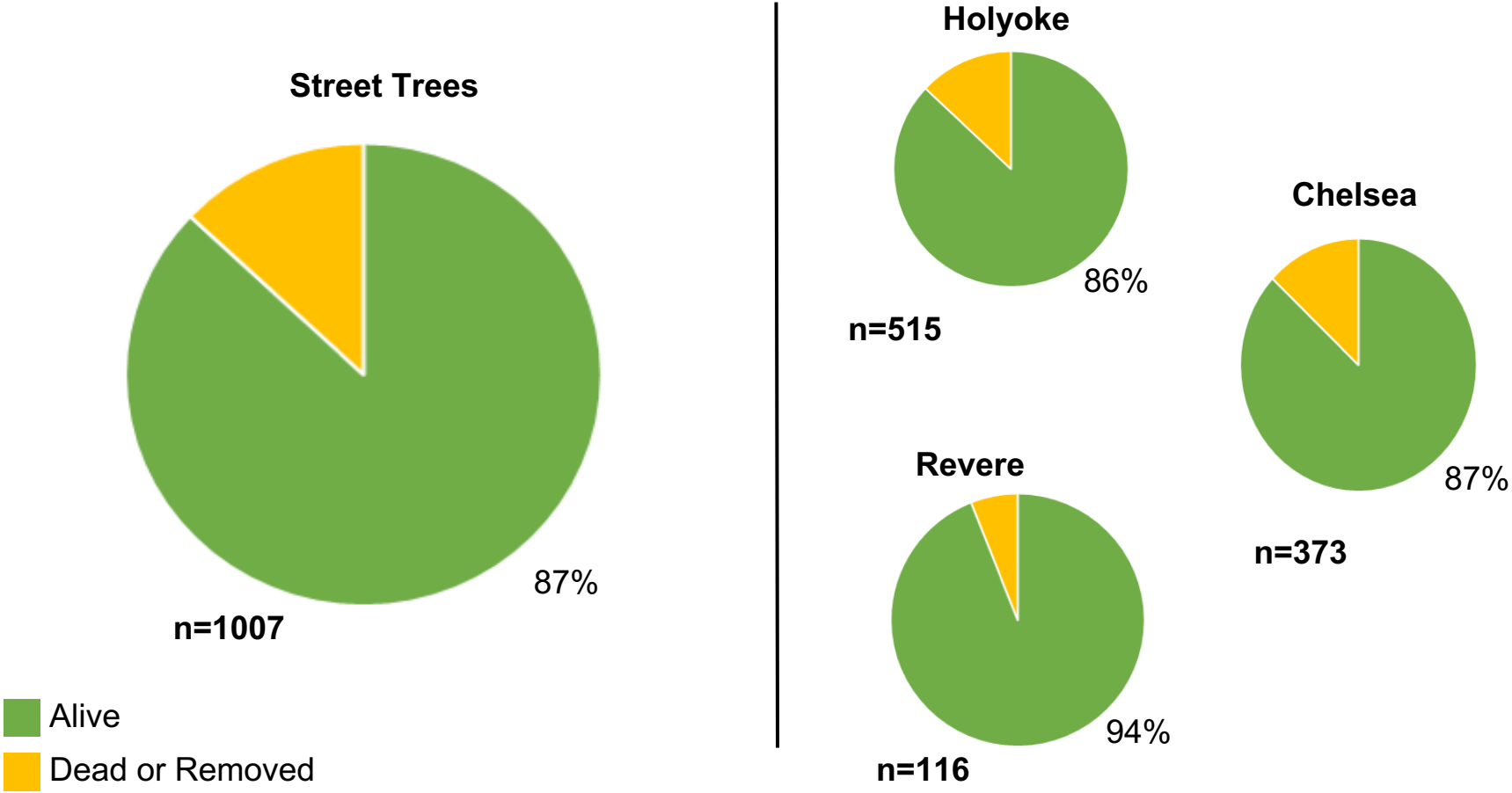
Convenience sample of tree health
Private residential/non-residential trees were surveyed based on individuals' willingness to participate

Stewardship responsibility
Maintained by private residents or institutions

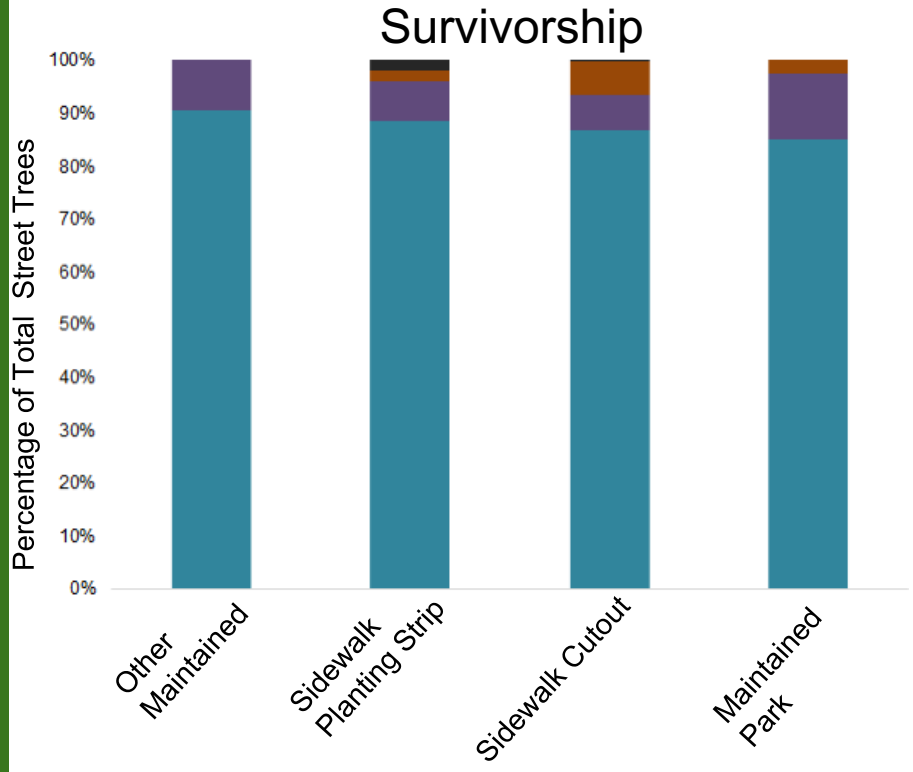
Size
Generally a smaller caliper stem at planting (1.5-2.0 in)

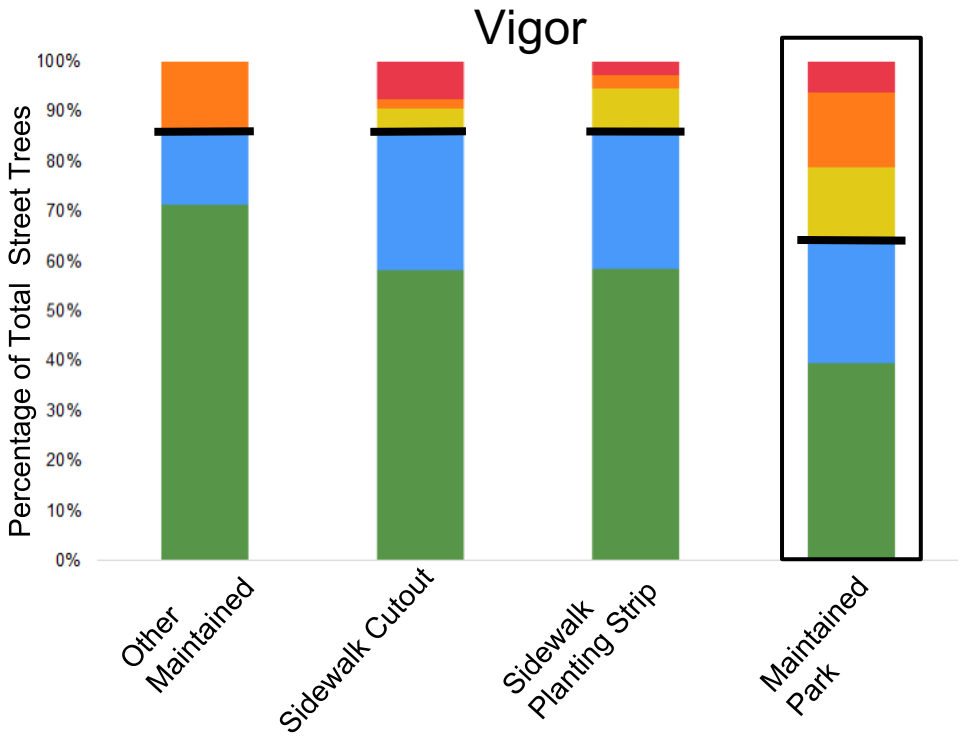
Stresses
Include damage from landscaping & infrequent watering

Survivorship for Street Trees

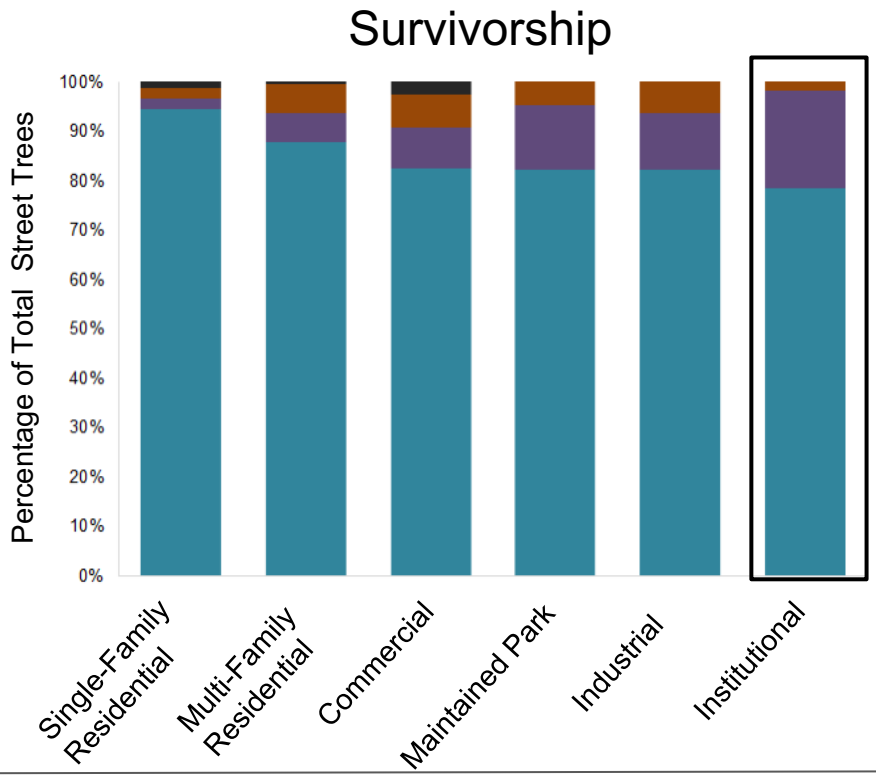


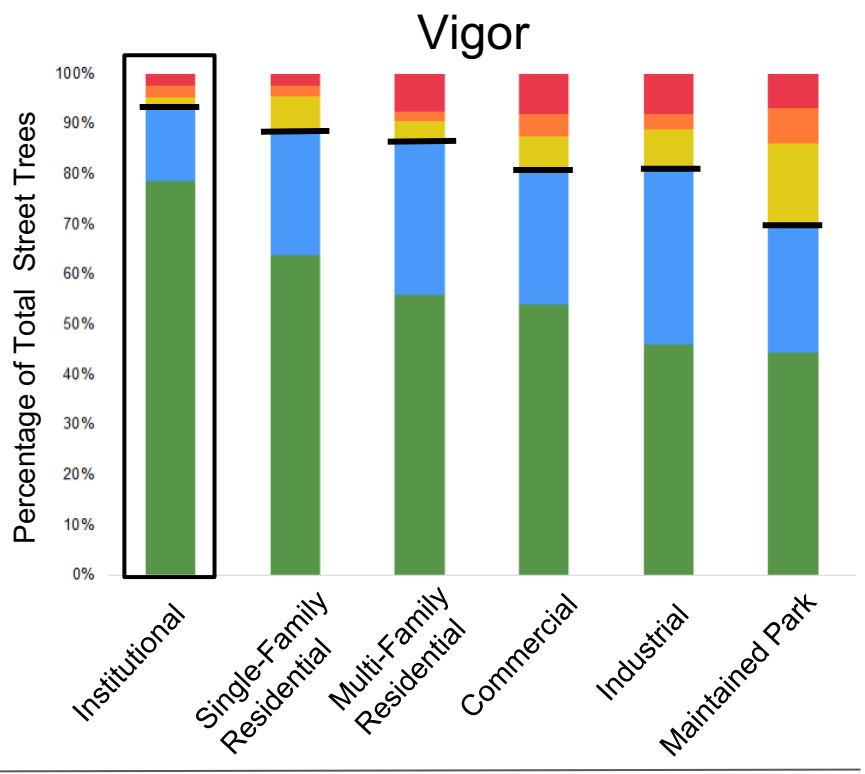
All Street Trees: Site Type





All Street Trees: Land Use





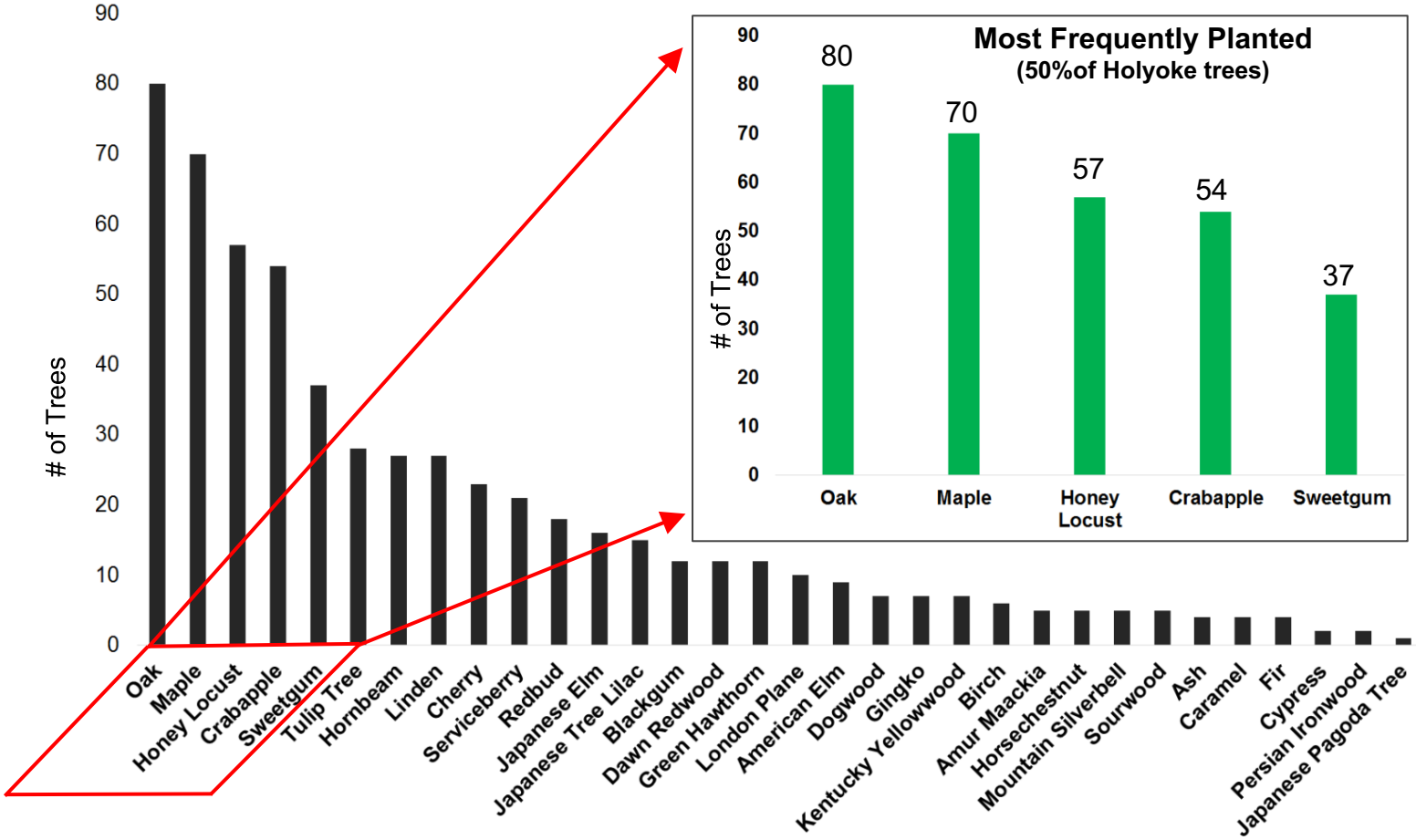
Alive
Removed
Standing Dead
Unknown

Healthy
Moderately Unhealthy
Dead
Slightly Unhealthy
Severely Unhealthy

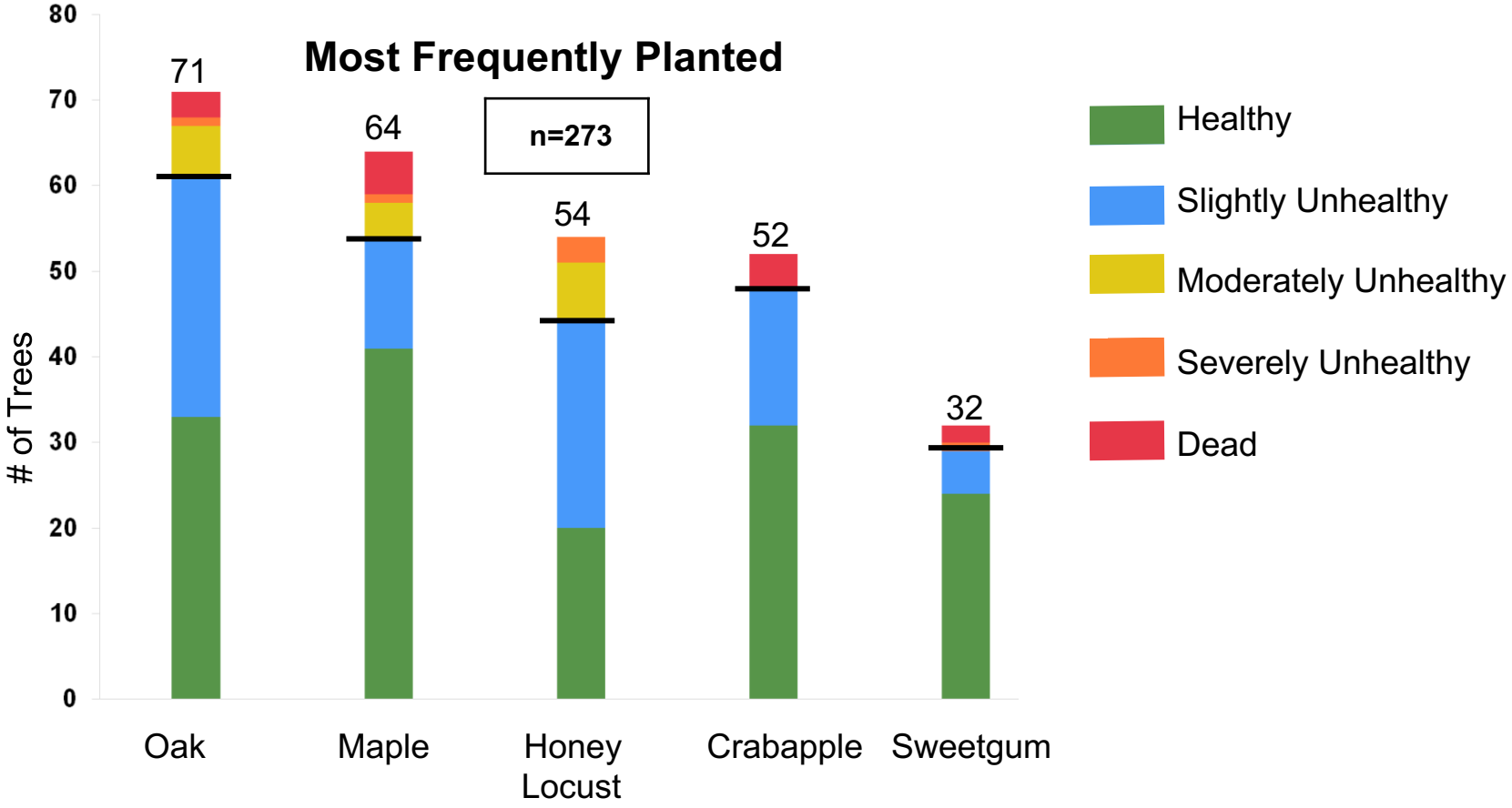
Comparison Of All Street Trees

	% Alive	Mean DBH (In.)	Mean Height (Ft.)	Mean Vigor	Mean Crown Width (Ft.)	Number of Trees
All	87	2.14	12.3	1.72	6.28	1005
Holyoke	86	2.25	11.8	1.72	6.04	515
Chelsea	87	2.17	13.4	1.78	6.87	374
Revere	94	1.68	11.5	1.51	5.48	116

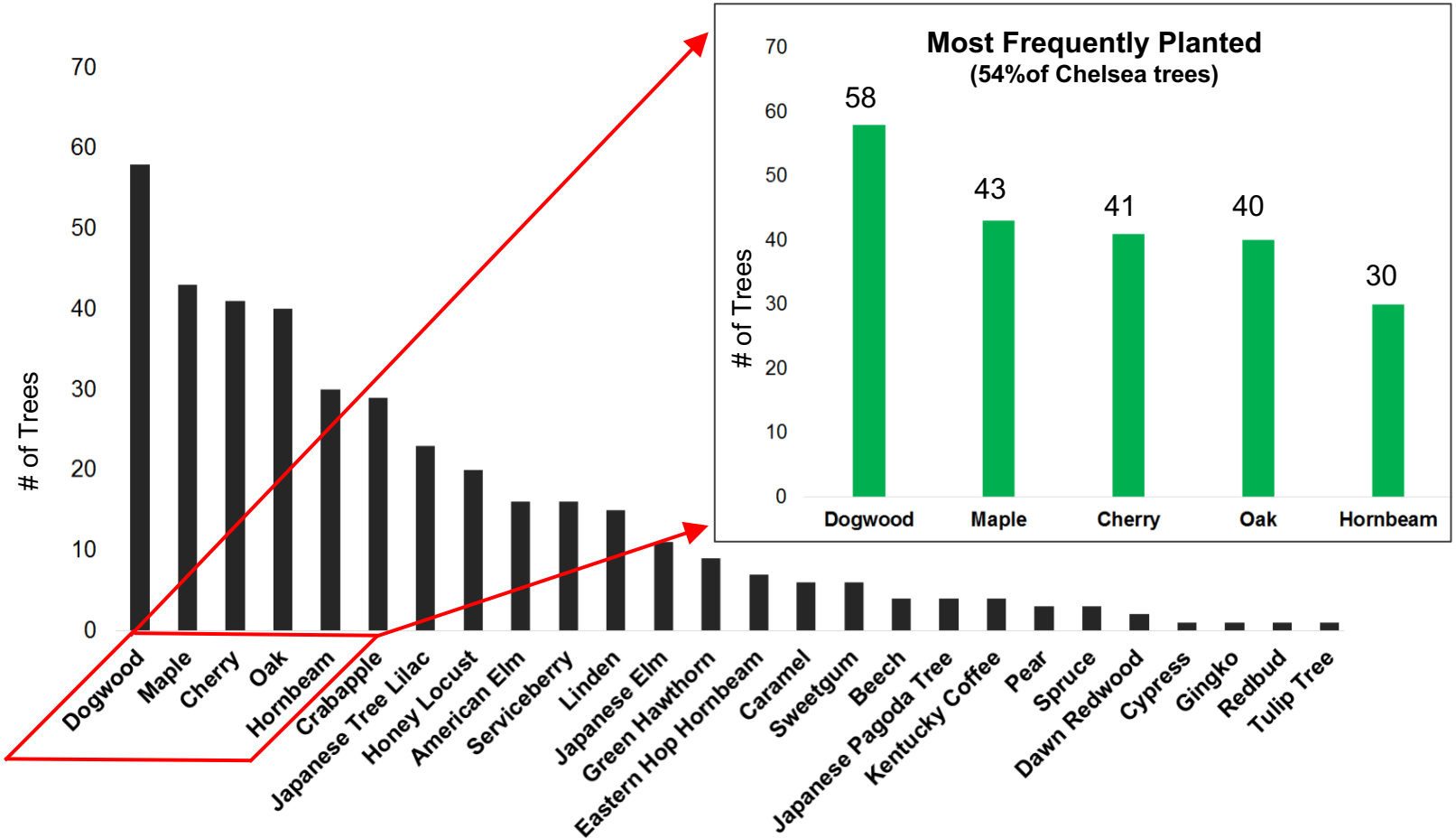
Holyoke: Street Tree Species Composition



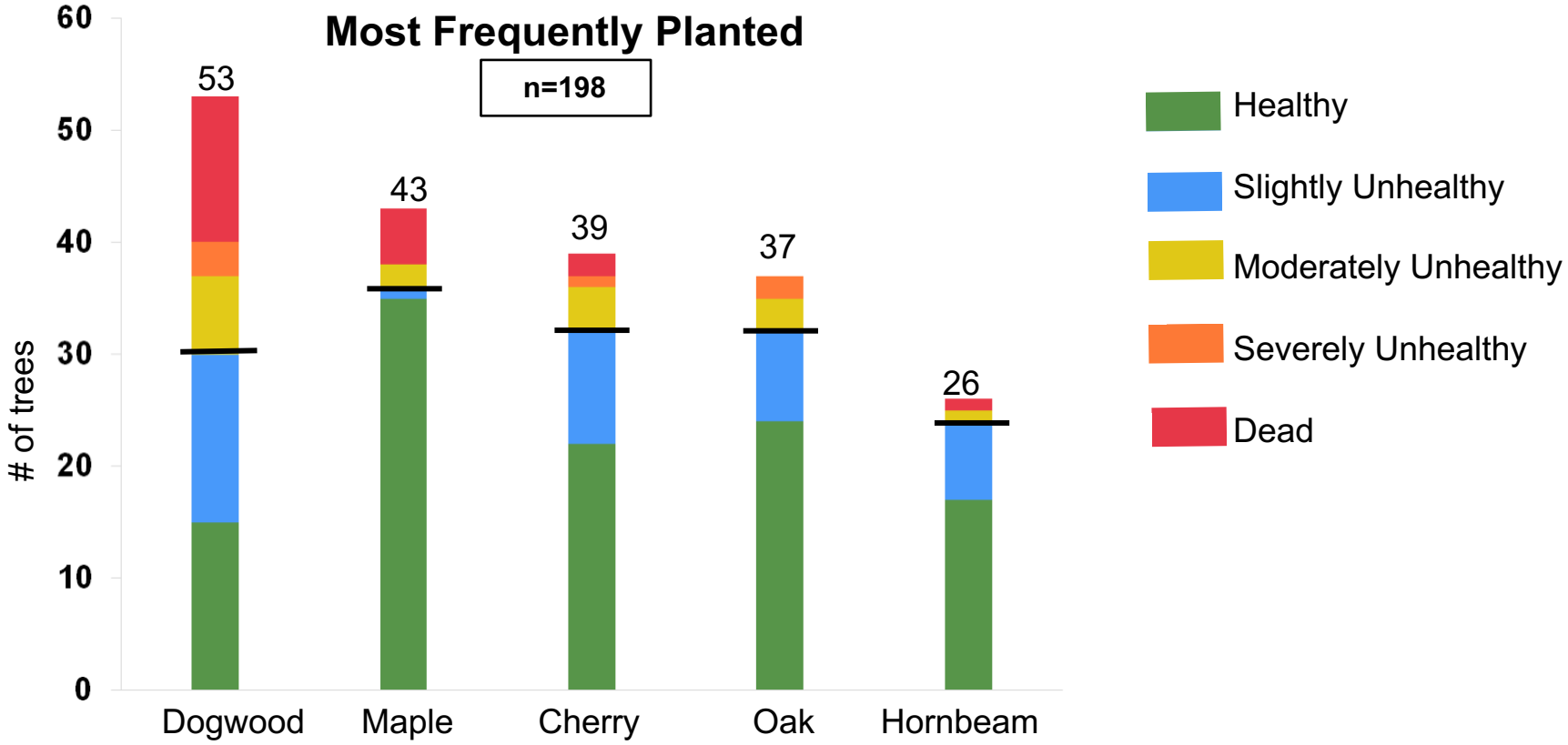
Vigor of the Most Frequent Street Trees in Holyoke



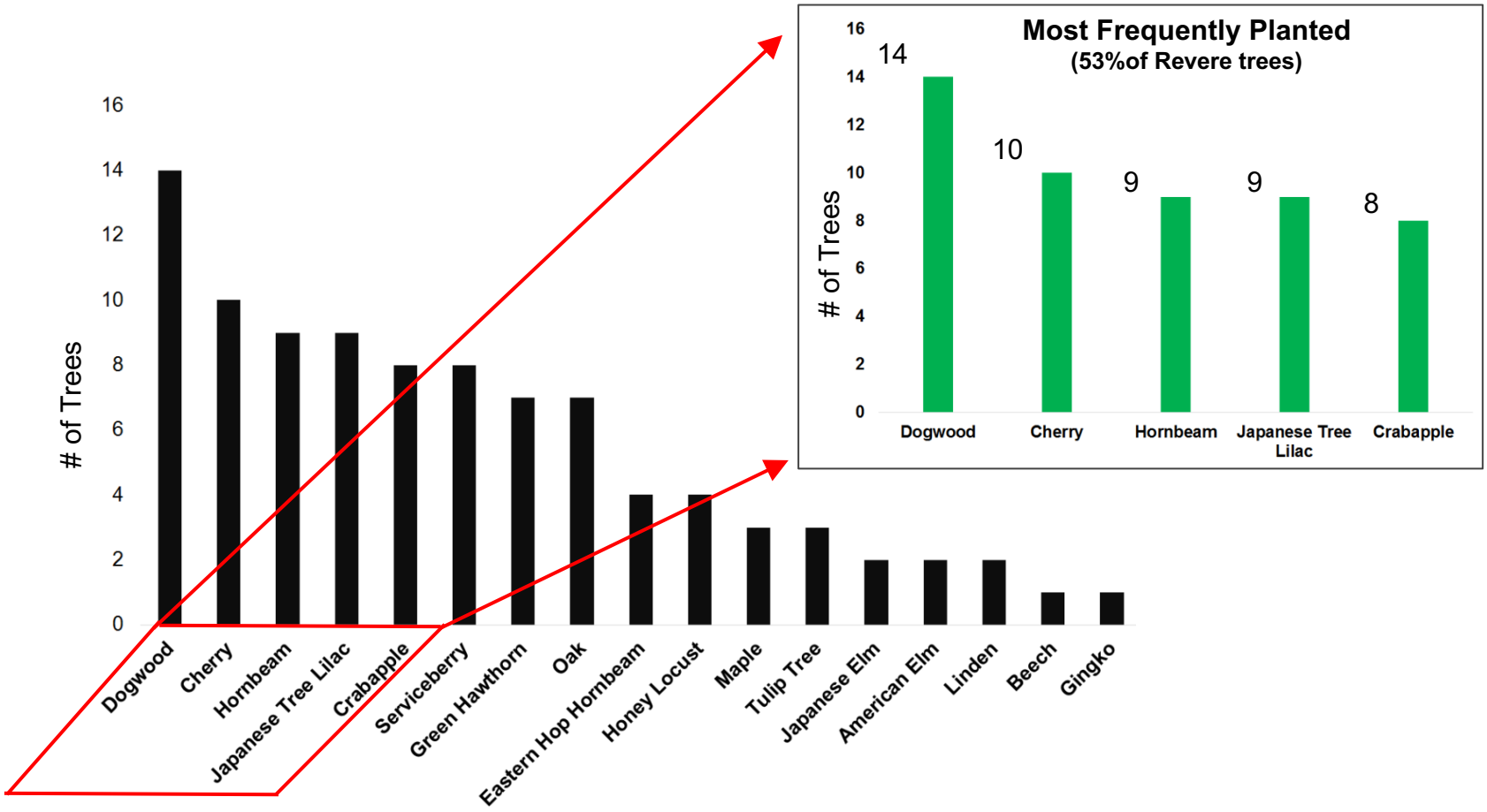
Chelsea: Street Tree Species Composition



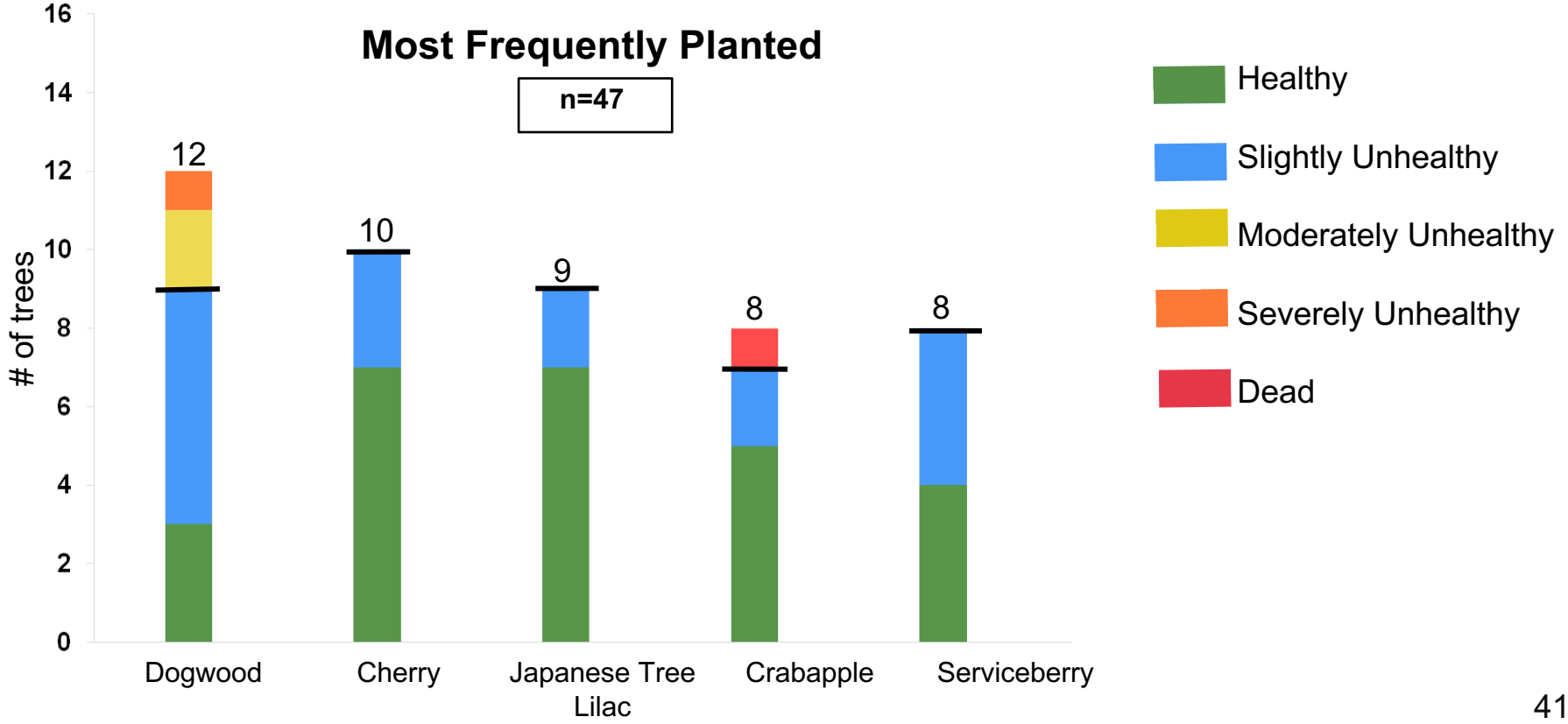
Vigor of the Most Frequent Street Trees in Chelsea



Revere: Street Tree Species Composition



Vigor of the Most Frequent Street Trees in Revere



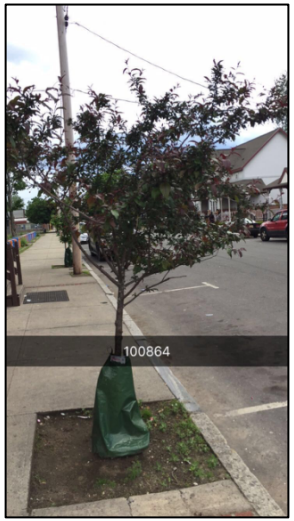
Best Performing Street Tree Species

Honey Locust

Excellent performance in all three cities

Cherry Plum

Excellent performance in Holyoke and Revere



Crabapple

Excellent performance in Chelsea and did well in Revere

Pin Oak

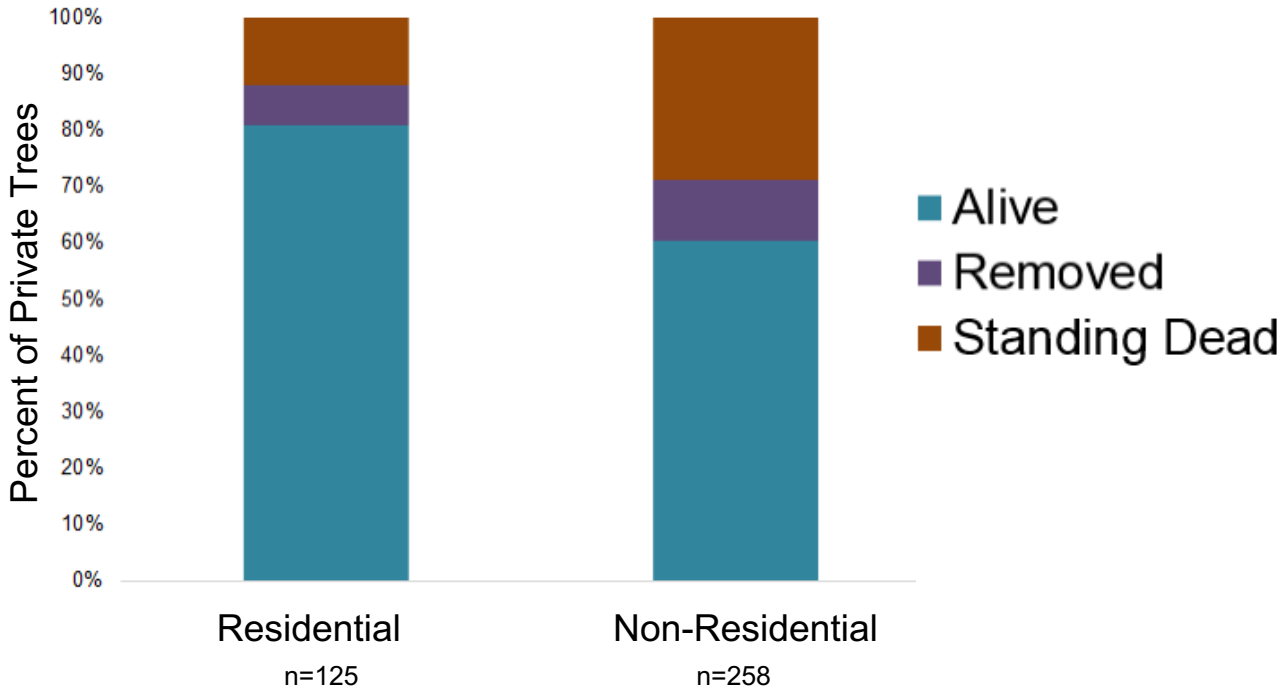
Excellent performance in Holyoke and did well in Revere

Japanese Tree Lilac

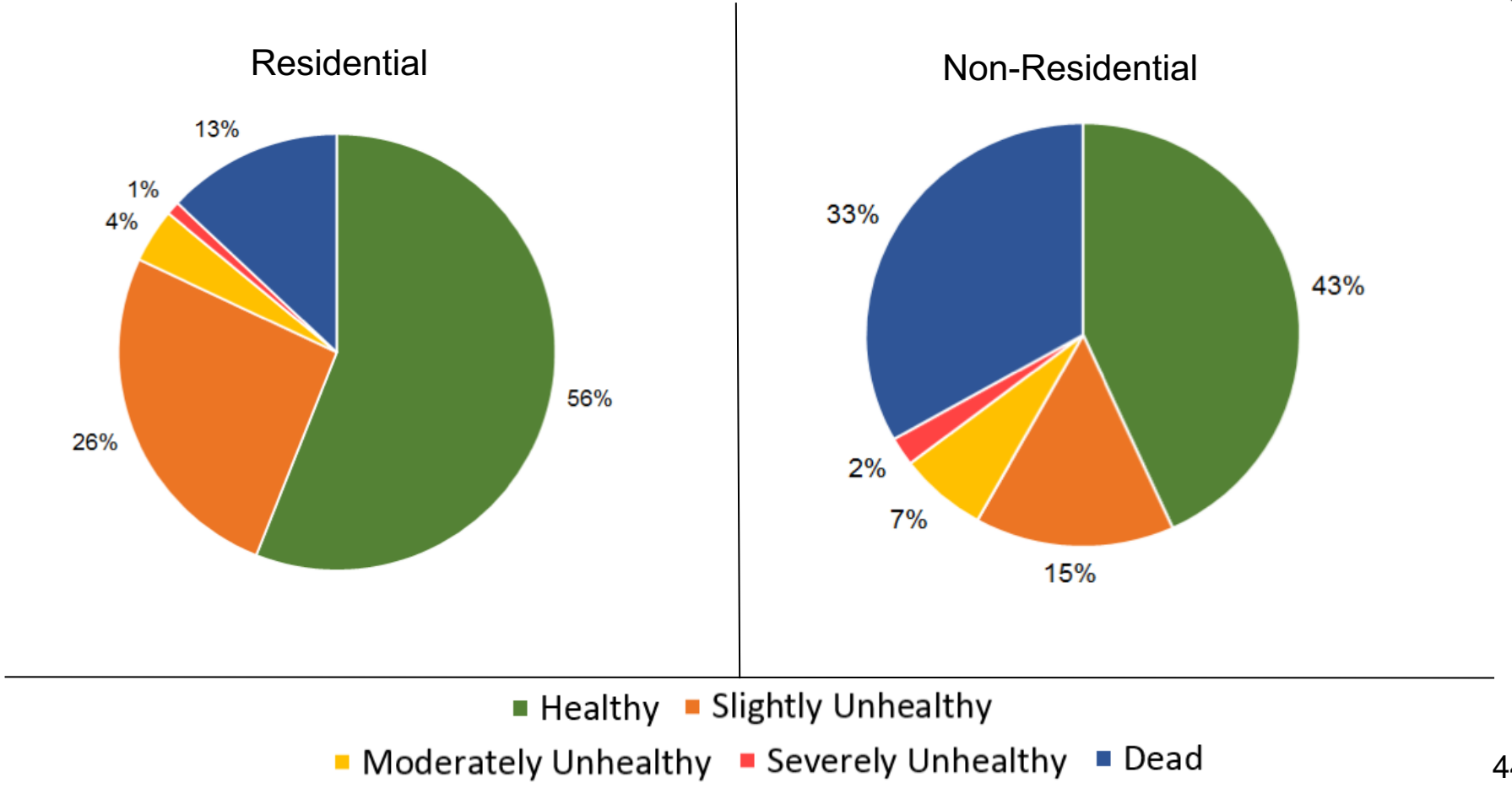
Excellent performance in Holyoke and Revere, did well in Chelsea

Private Tree Sample

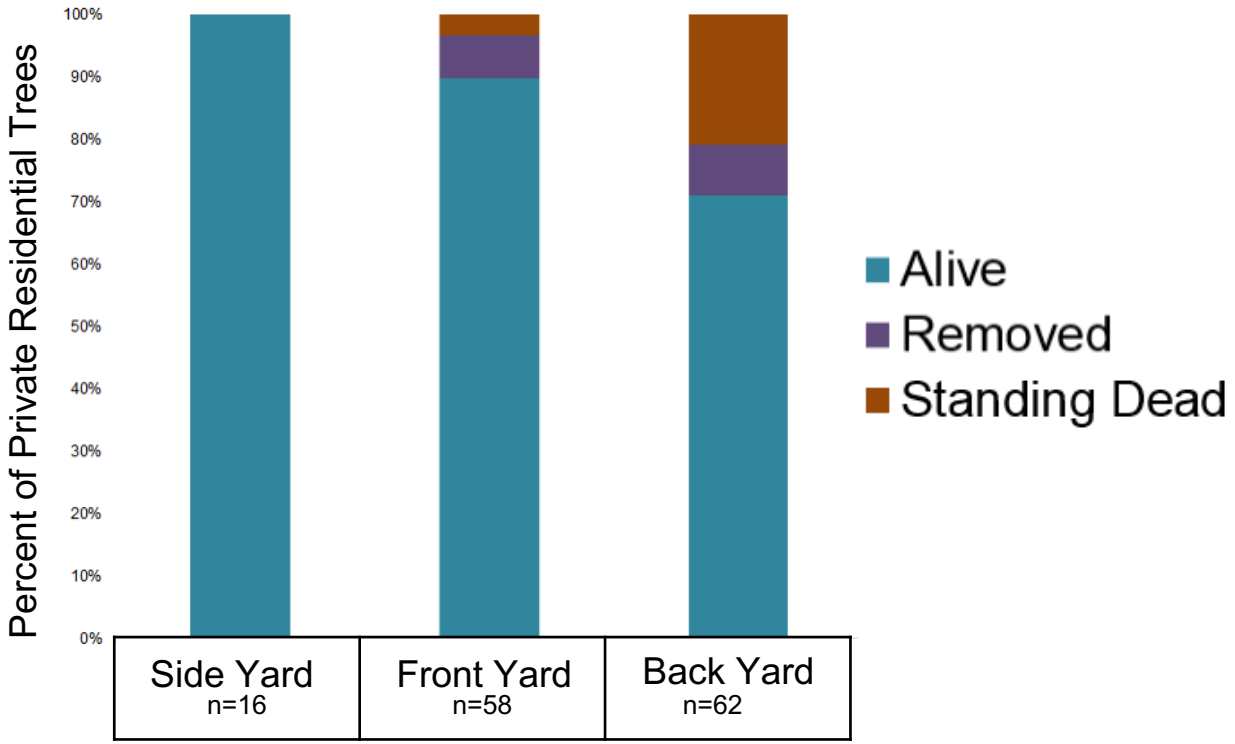
% Alive	Vigor	DBH	Height	Width	n
67	2.41	1.08 in	8.0 ft	3.21 ft	383



Vigor Distribution of Private Trees



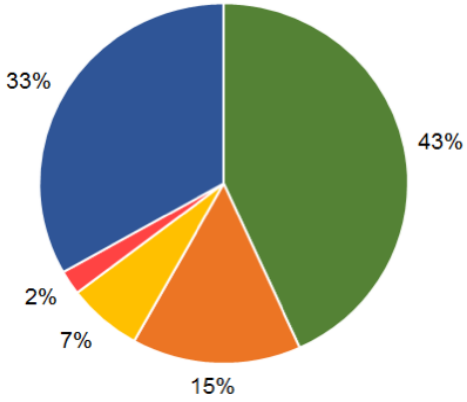
Private Residential Trees



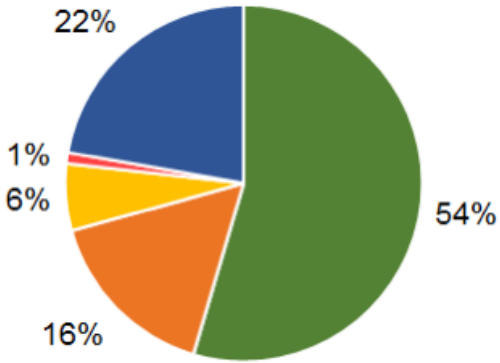
There is no significant difference between Single and Multi-family properties

Private Non-Residential Trees

All (n=258)		Subsample Controlling for Bias
60% Alive	Vigor	67% Alive



- Healthy
- Slightly Unhealthy
- Moderately Unhealthy
- Severely Unhealthy
- Dead



No significant difference in DBH

Private Trees Holyoke

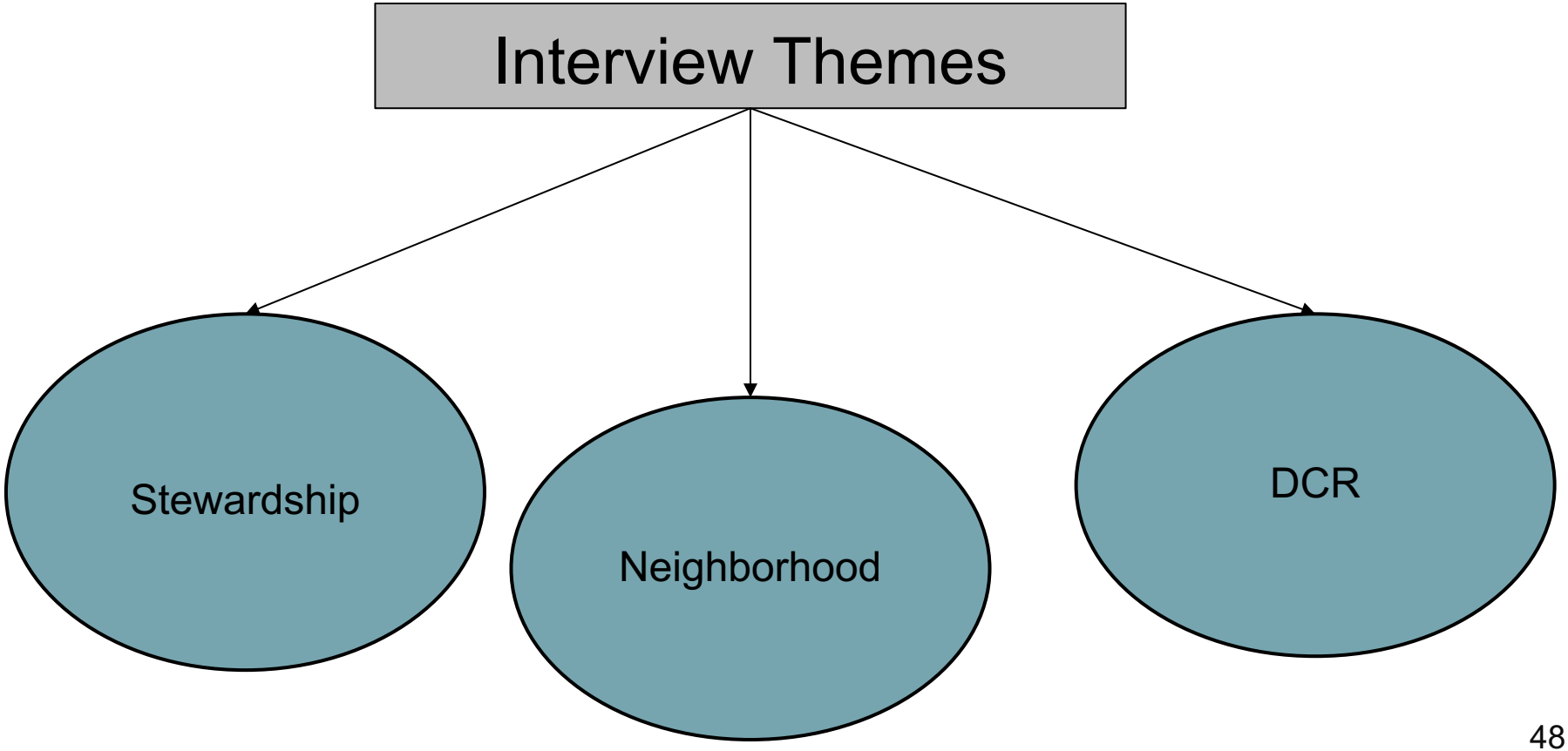
%Alive	Vigor	DBH	Width	Height	N
64	2.53	0.99 in	2.84 ft	7.7 ft	327

- One third of Holyoke's private trees are on just two properties
- Without them: 75% Alive, Vigor 1.98, DBH is the same

Private Trees Chelsea

%Alive	Vigor	DBH	Width	Height	N
82	1.72	1.57 in	5.8 ft	10.2 ft	57

There is no significant difference between cities within residential trees

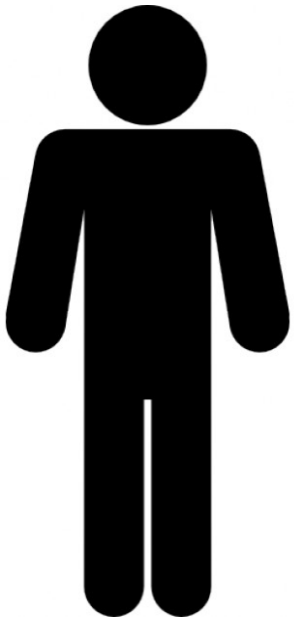

Interview Themes
Stewardship
Neighborhood
DCR

Demographics

50% female

Ethnicity/Race:
67% white
16.5% American Indian/Alaska Native 16.5% Hispanic/Latino
Language(s):
English
Age
>45 years old
Educational Attainment:
33% Trade/Technical Schooling
16.6% Some College
16.6% Associate Degree
16.6% Bachelor's Degree
16.6% Master's Degree

50% male



Total Participants: 8
(6 responded to demographic survey)

How did residents find out about the program?

Flyers & Mailings (6)

"They came around with flyers, I believe it was about the Chelsea planting program. I said sure, I'll have a couple."

"I received a notice in the mail, it came with my water bill I believe."

Neighbor Networking (3)

"I called my neighbors and they got some too."

"When they put the trees here, my neighbors requested some as well."

HERO Eli Baldwin in the field.

What motivates residents to participate?

Aesthetics (4)

"I figured it was a nice way to make the yard and everything more beautiful."

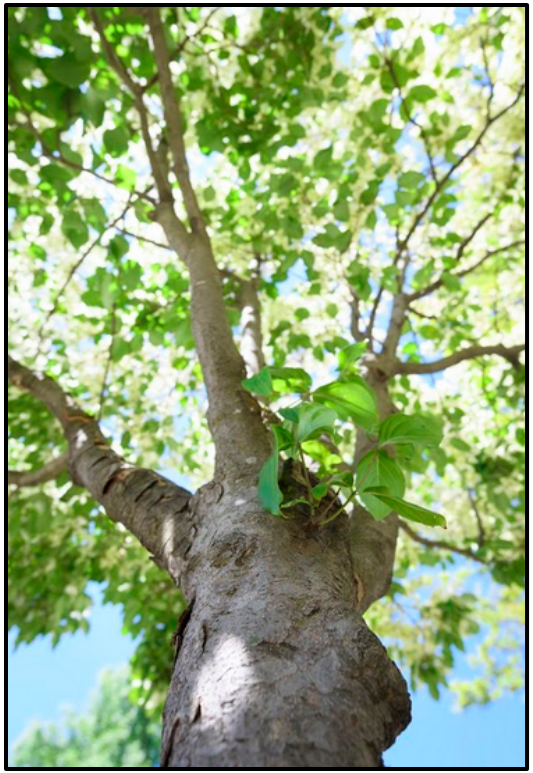
"It makes the property look so much nicer with the greenery around."

Ecosystem services (4)

"We get fresh air and it's nice and cool here. Over there it's really hot and you never see anyone in the yard because there aren't trees."

"To add to the yard, and the shade in the future."

"I like to make my yard as close to nature as I can, I like the birds and the habitat and they're good for the environment."



How was their experience with the DCR?

DCR foresters in the field

Receiving Information (5)

"They told me how to take care of them, give them so much water a week and stuff like that."

"I did not even think to call them."

"If I had a question about a tree, I would go on the internet."

General Comments (4)

"You people work hard and are very dedicated, everybody was very positive."

"You don't think about it that much until you're actually sitting down talking with someone about it. That's what I think helps a lot- **someone** coming down and talking to you about it."

How does it help their community?

"I hope it cleans the air."

"It's really pretty, it makes a big difference in the city, going down the street and seeing all the trees."

"I've lived in Chelsea my whole life and I can say there are a lot more trees."

"It's good, but it (the planting program) needs more attention and awareness."

DCR & DPW tree planting in Chelsea

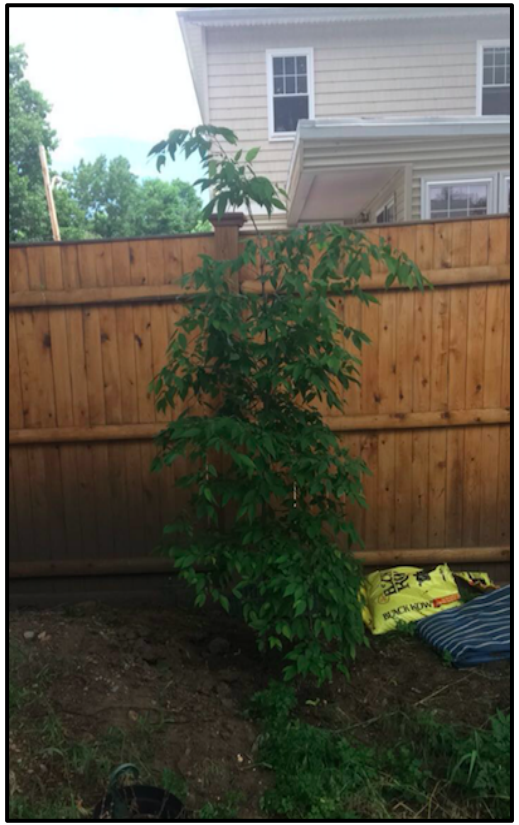
How did the residents care for their trees?

"I was watering the tree every other day."

"In fact, I'm watering the ones they planted outside on the sidewalk also."

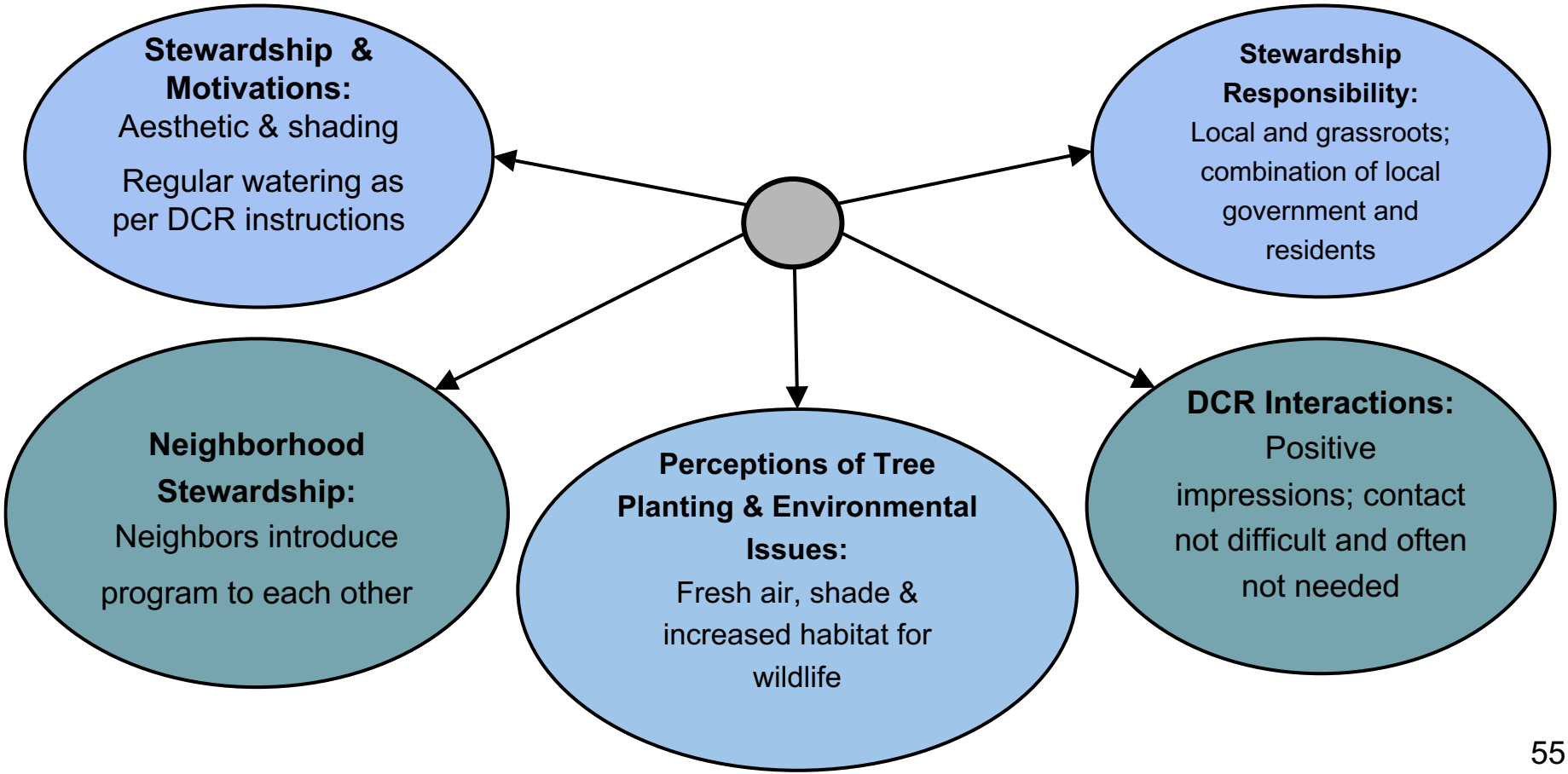
"My brother was the one who watered them and everything."

"If it's in the yard, it should be the owner."



Examples of Resident Tree Care

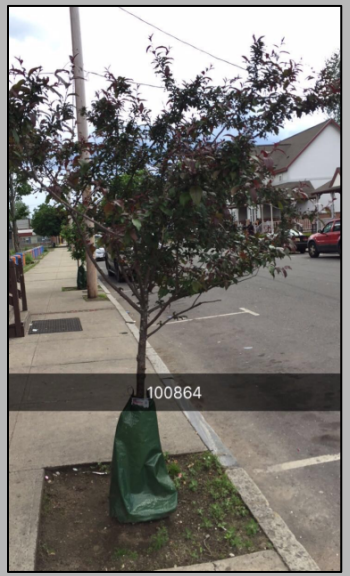
Interview Themes



Take-Aways: Species Performance

Frequently Planted ✓

Crabapples & **Honey Locusts** performed well



Frequently Planted ✗

Dogwoods & **Tulip Trees** performed poorly

Canopy Coverage

Of the top performing trees **Cherry**, **Honey Locust** & **Crabapple** provide the largest canopy cover

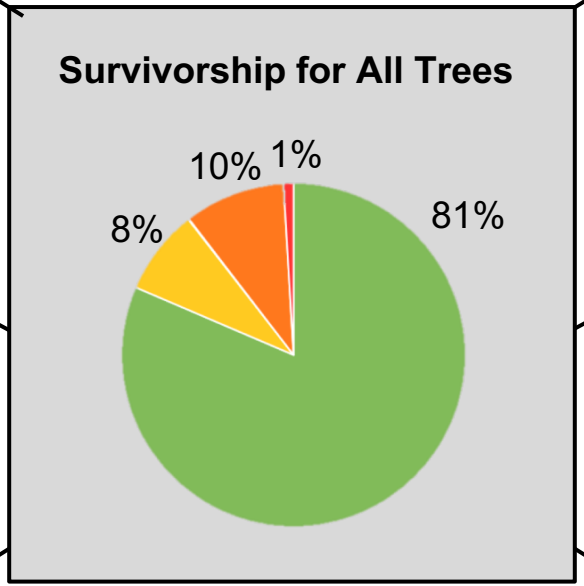
Across All Cities

Honey Locust performed the best across all three cities and provides the most canopy cover

Take-Aways: Other Trends

Housing type was not significant in survivorship of private trees.

Front yard trees perform better than backyard trees.



Street trees performed better than private trees.

Maintained parks and other maintained areas performed poorly compared to other land uses.

Private, non-residential trees had lower survivorship than private residential and street trees.

Street trees on institutional land use had high mortality though surviving trees had higher vigor than trees on other land uses.

Future Research and Policy Suggestions

1. Understand factors related to tree health and survivorship

- Continue surveying trees to monitor growth patterns and stewardship
- Model the ecosystem services that the future canopies will provide
- Investigate the effects of soil composition & shading on tree health

2. Understand the contribution and experience of residents and stakeholders

- Conduct more interviews to get a more demographically representative sample
- Identify communication gaps in tree stewardship with maintainers & landscape companies
- Understand why people choose not to participate in the program and how to strengthen partnerships with local grassroots organizations

Acknowledgements

Principal Investigators

John Rogan
Deborah Martin

Managers

Zhiwen Zhu
Marc Healey
Arthur Elmes

Worcester Tree Initiative

Ruth Seward
Derek Lirange

Resident and Stakeholder interviewees

Clark University & The O'Connor '78 Fund for Environmental Studies

Administrative Support

Rachel Levitt
Kayla Peterson
Pamela Dunkle

DCR

Matt Cahill
Ahron Lerman
Rachel De Matte
Hilary Dimino

U.S. Forest Service

Lara Roman

University of Massachusetts Amherst

Theodore Eisenman
Ben Breger
Madison Kremer

CLARK UNIVERSITY

The HERO Team at Dodge Park

Thank you.