Tree Collections or Urban Woodlands?

Tree management, planning, and urban forest modeling for small gardens

Ray Leimkuehler

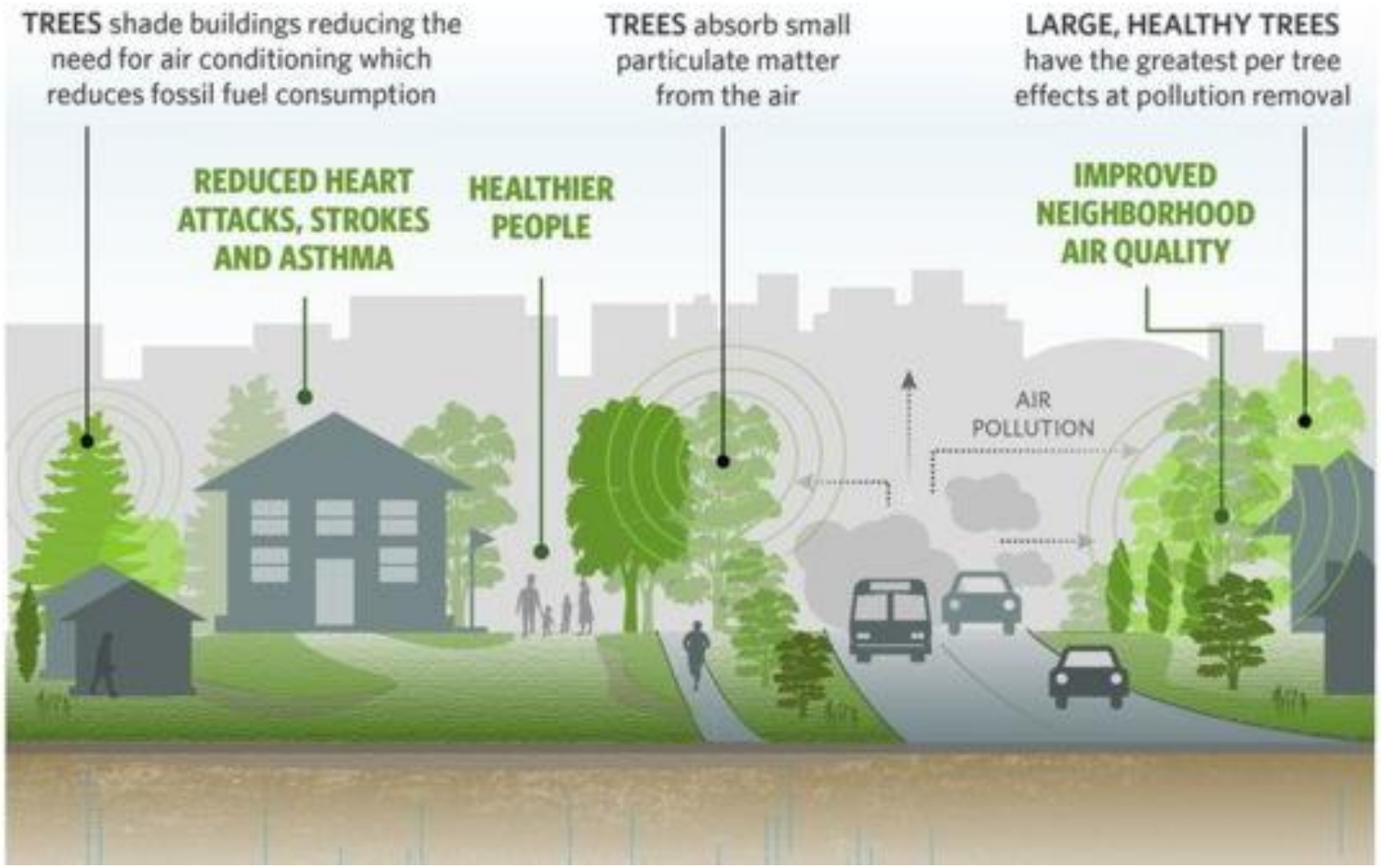
Ethnobotany Horticulturist, Lead Arborist

Desert Botanical Garden

rleimkuehler@dbg.org

Improves the Air and Human Health

- Reduces asthma
- Reduces recovery times in hospitals
- Lowers stress in human beings

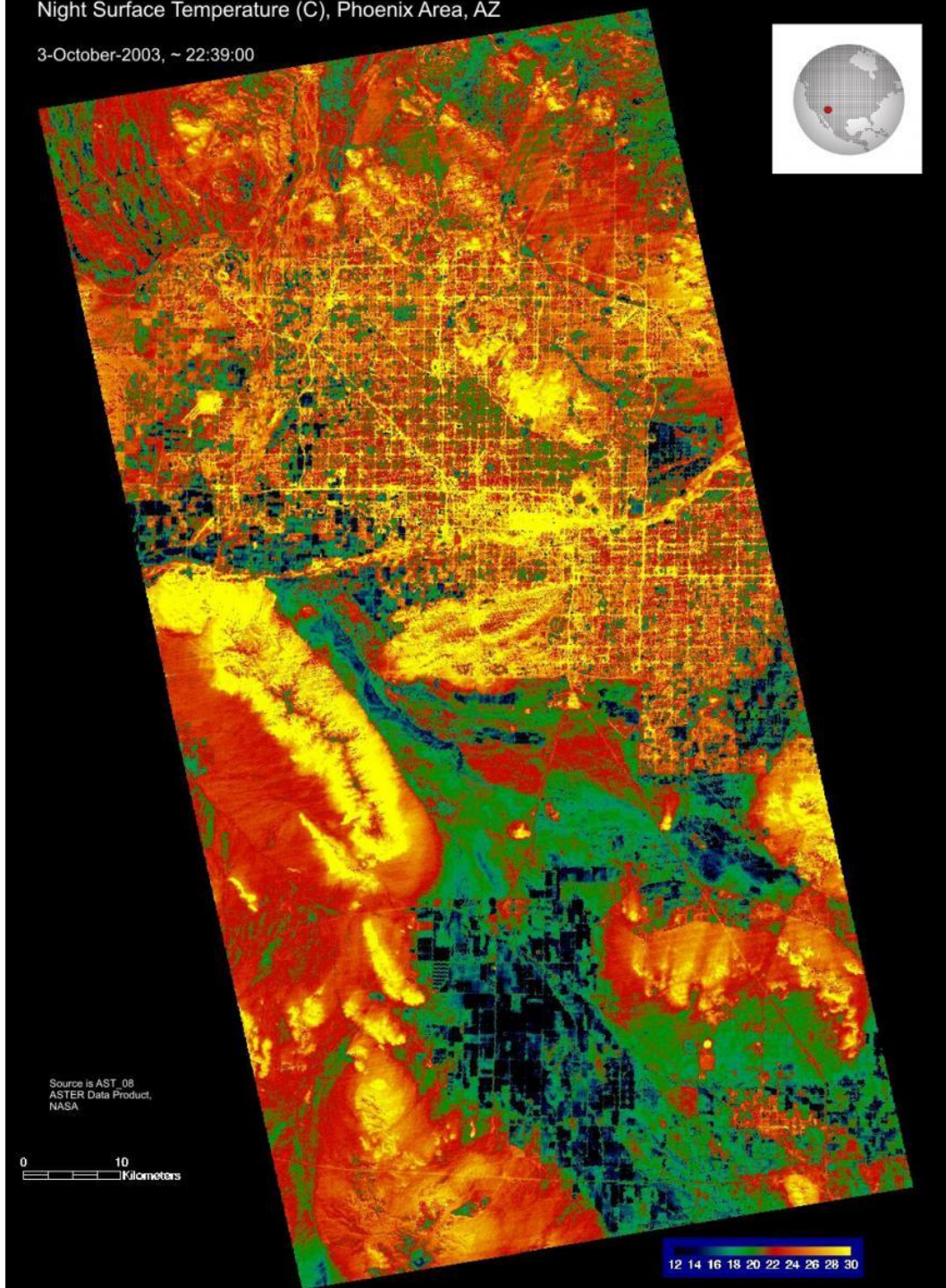


Urban Heat-Island Effect

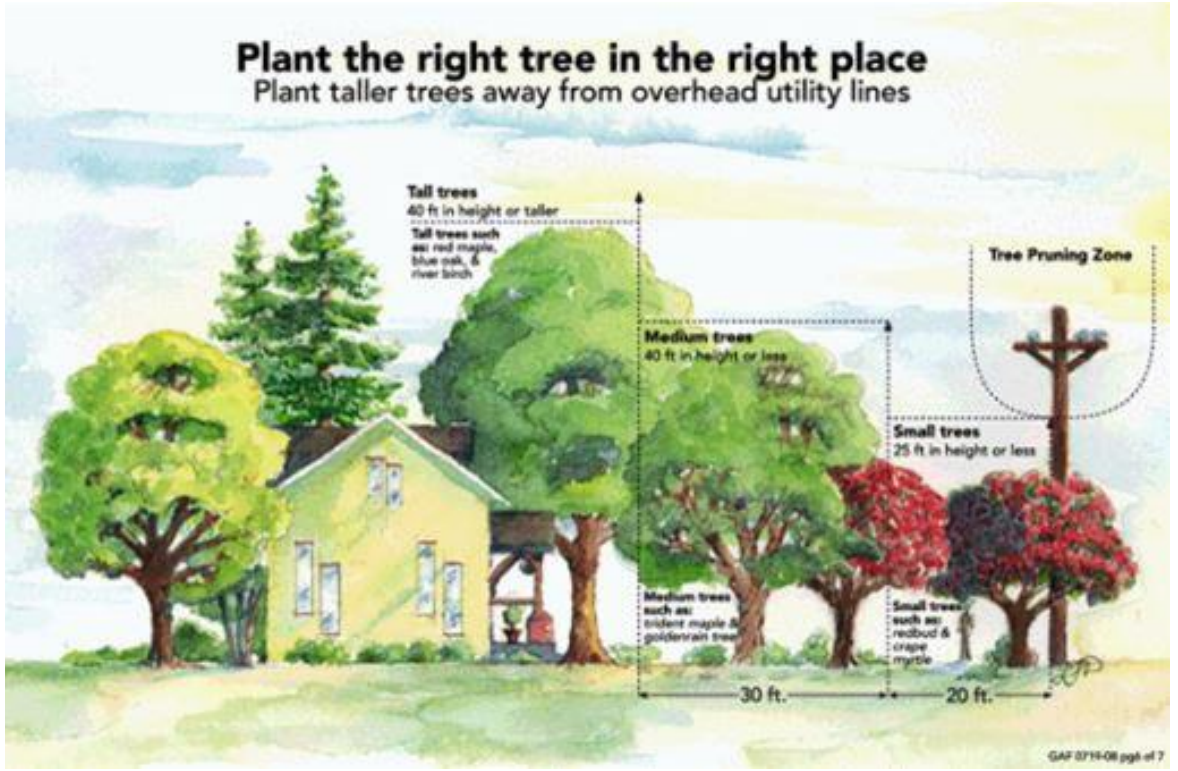
Buildings and streets absorb heat throughout the day and radiate it back into the atmosphere at night.

Evapotranspiration from vegetation can help lower urban temperatures on a city-wide scale by 2-7°F (City of Phoenix 2010, p. 20).

This increases overall city temperatures so that the urban environment never cools, driving up energy use and water consumption. Studies have shown that in the month of June, for a typical family, 290 gallons of water are consumed for every 1° F increase in temperature (City of Phoenix 2010, p. 20).



Energy Conservation



Planting trees on the west and south sides of the yard to shade the house, can reduce cooling costs by 25% annually (City of Phoenix 2010, p. 21).

Carbon Sequestration and Climate Change

Temperatures are anticipated to increase here in the Southwest. Scientists estimate that the Colorado River system will experience a decrease in recharge by 10-20% in the next 50 years, mostly in the Lower Colorado River watersheds (Meixner et al, 2016).

Trees sequester carbon in the trunks and root systems. Urban forests across the United States store 708 million tons of carbon and sequester 28.2 million additional tons each year (Nowak, Greenfield, Hoehn, and Lapoint, 2013).

Premise: So Many Trees, So Little Time

- 1,928 trees planted across 54 acres in the Desert Botanical Garden
- 237 species
- 35 trees per acre
- 42% canopy coverage

Divided Responsibilities, Mixed Results

- Increased International Society of Arboriculture (ISA) arborist certifications.
- Allowed trained arborist volunteers greater latitude in pruning.
- The results were mixed.

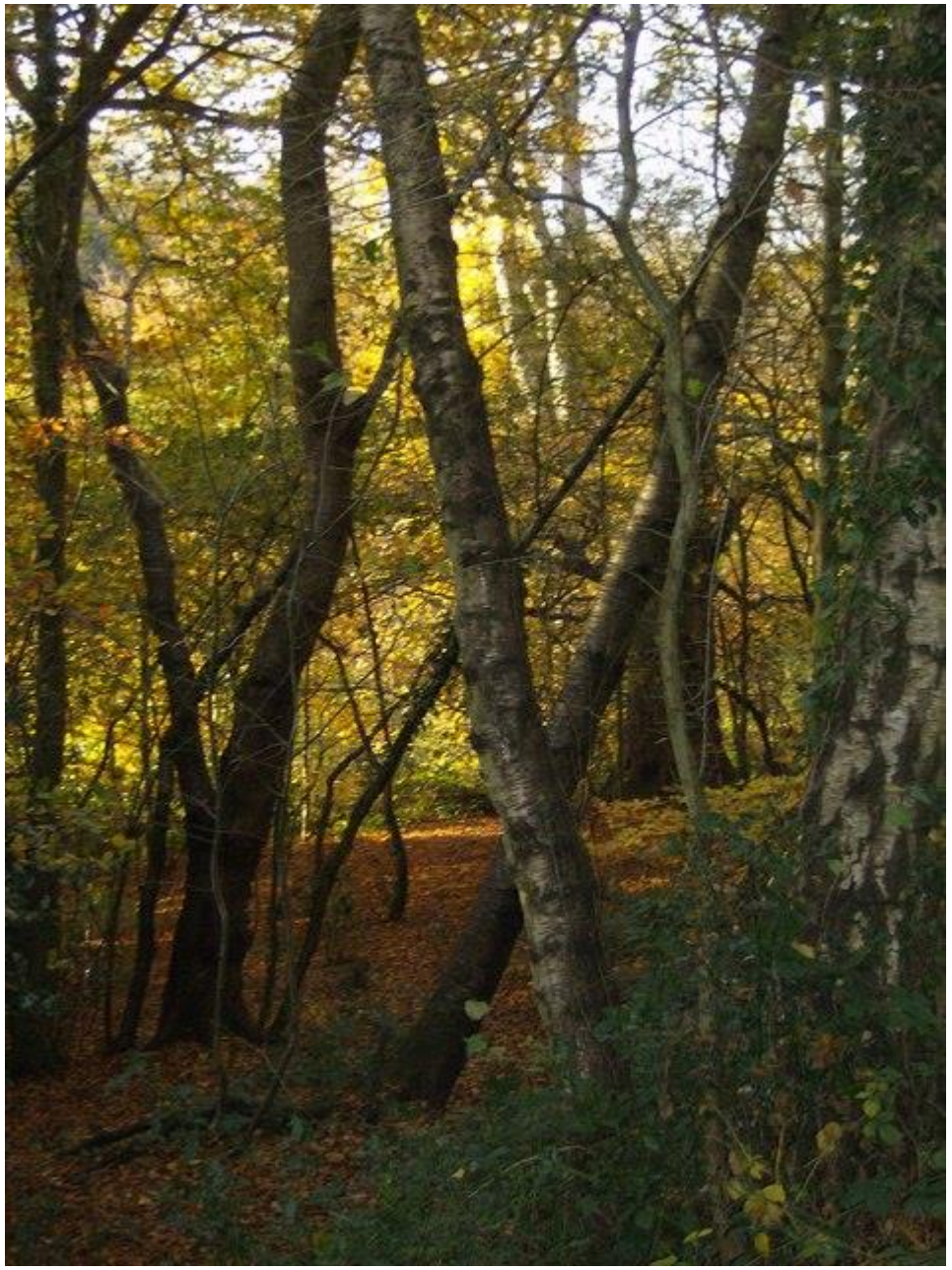
Forest for the Trees

Is this a plant collection, or an urban woodland?

The trees in a public garden are a community.

Managing trees one at a time is a reactionary form of management that ensures you always stay behind.

Scheduling work in line with the rhythms of the collection rather than reacting to changes in growth.



Volunteers

- Re-trained the volunteers with a focus on why pruning is done rather than how.

- Specified what tasks needed to be done, and developed a shared terminology for pruning

    i. Clearance Pruning

    ii. Lifting

    iii. Separation

    iv. Supervised Structural Pruning

Global Information Systems (GIS), Databases, and Maps

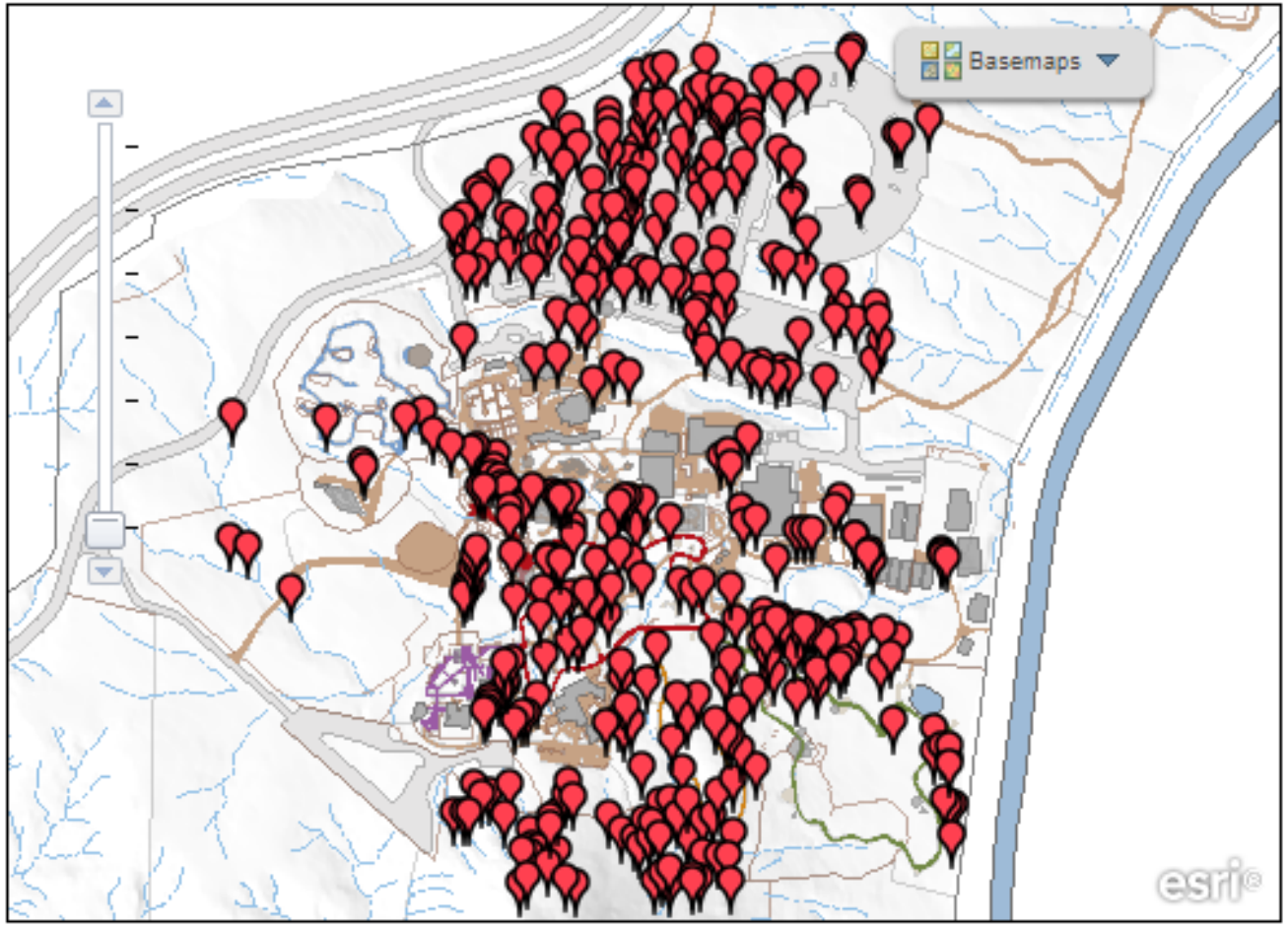
- Managing trees is easier if you know where they are and in what numbers.
- GIS trees: location, species (inventory).
- Tie this information into a database.
- Upload into mapping software.
- Spatial representation can allow for better understanding of the scope of work to be done.

“But, Ray, I Don’t Have A GIS Specialist!!!”

- APGA has an agreement with Esri to make mapping software available to public gardens for free.
- University GIS students-volunteers
- Local municipal foresters
- Private contractors
- Buy user-friendly software
- Google Earth

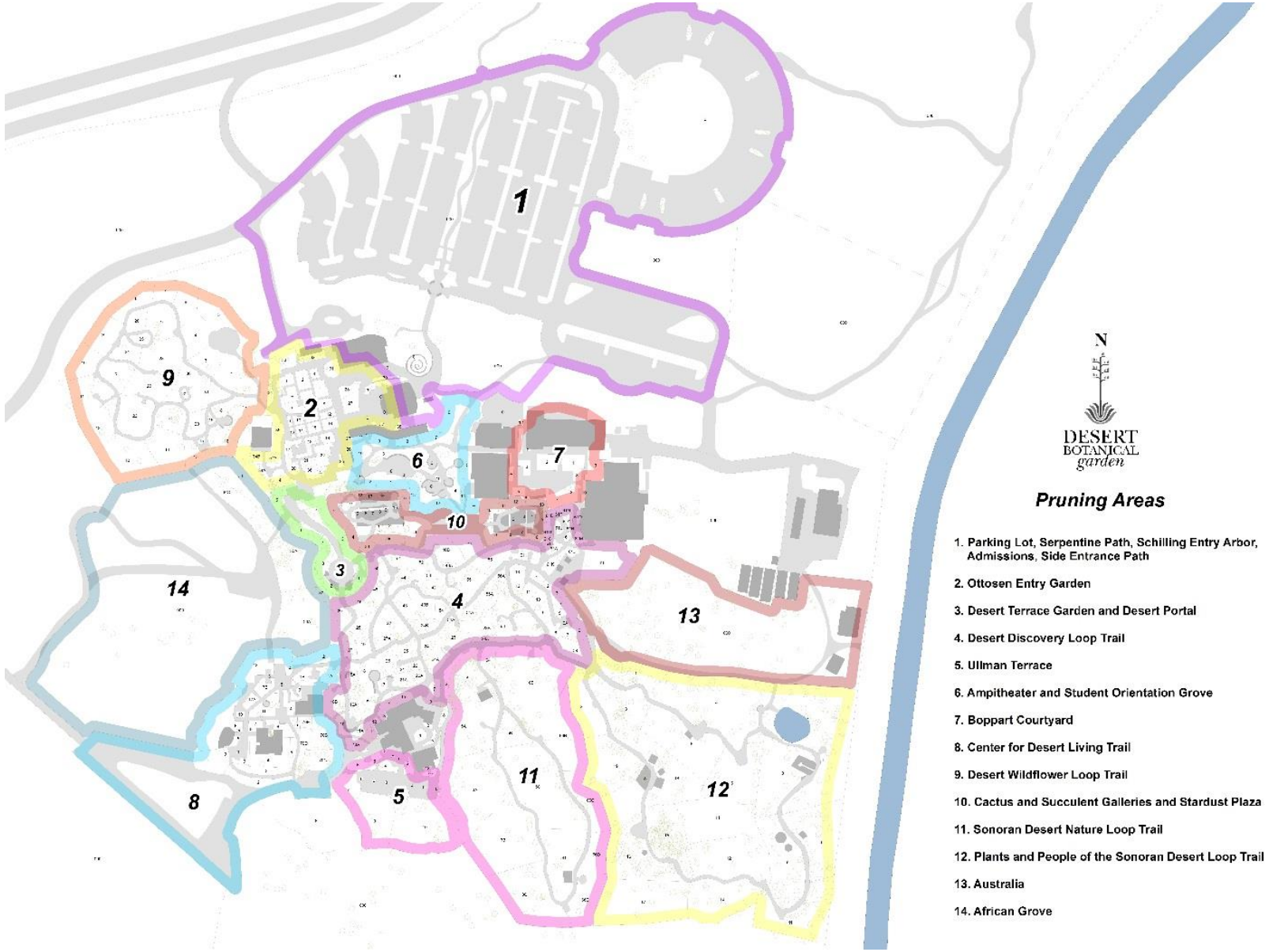
Parkinsonia Pruning

- 300 trees
- 30 to 15 minutes per tree
- 150-75 hours, or 3.5 to 1.5 weeks to prune that many trees

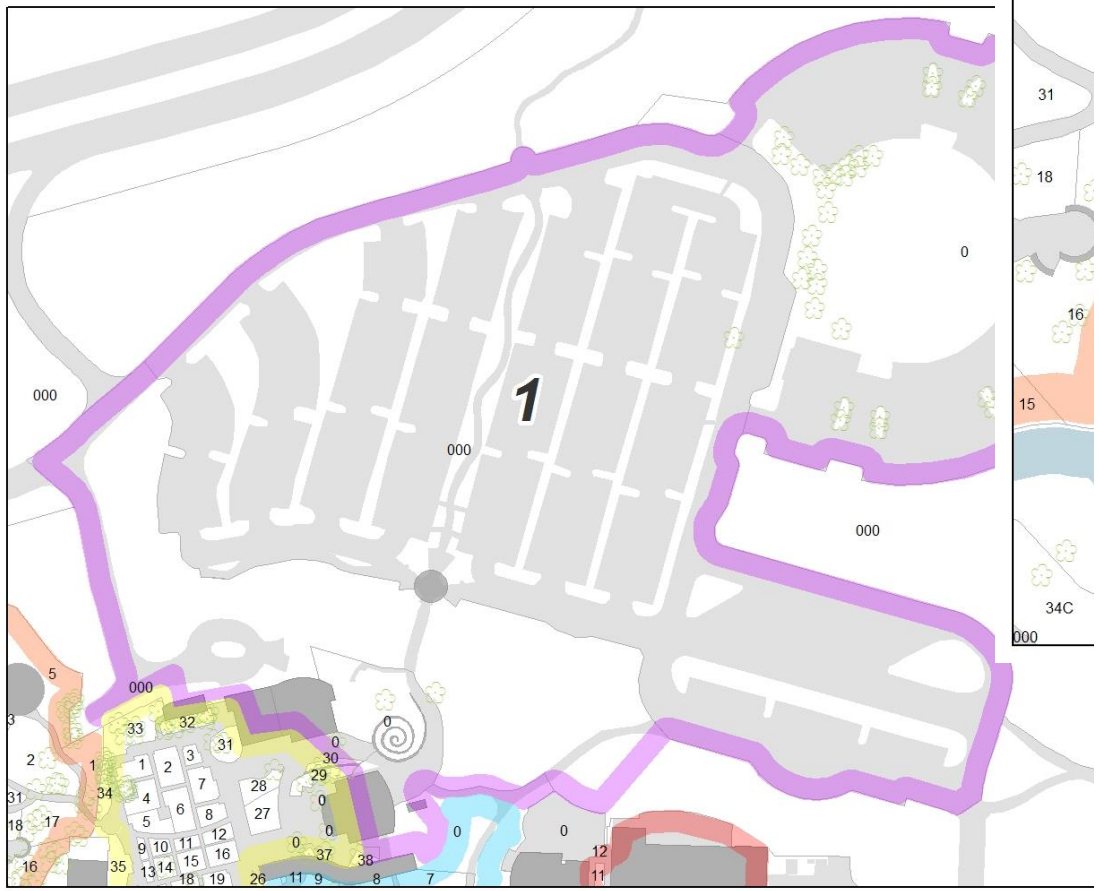


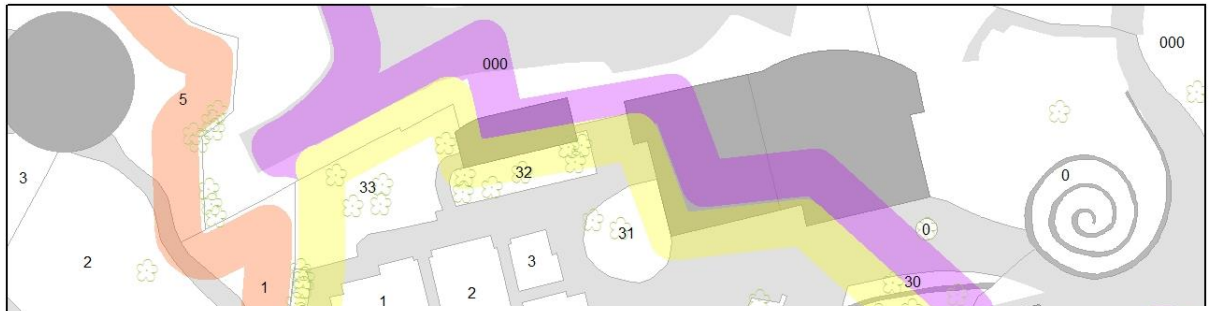
Pruning Plan

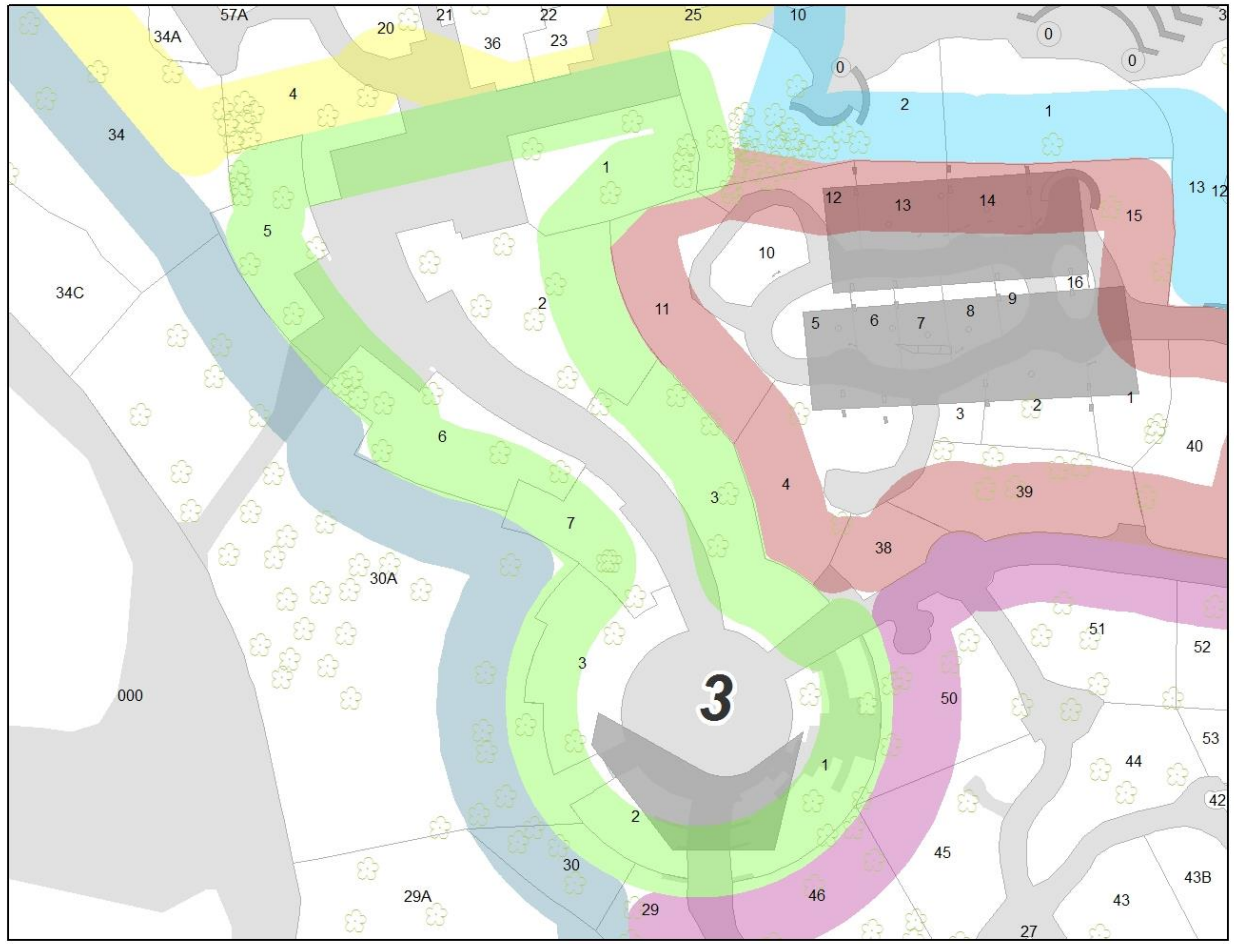
- A shared frame of reference for staff and volunteers alike.
- Sets priorities.
- Lets everyone know where they are supposed to be working.



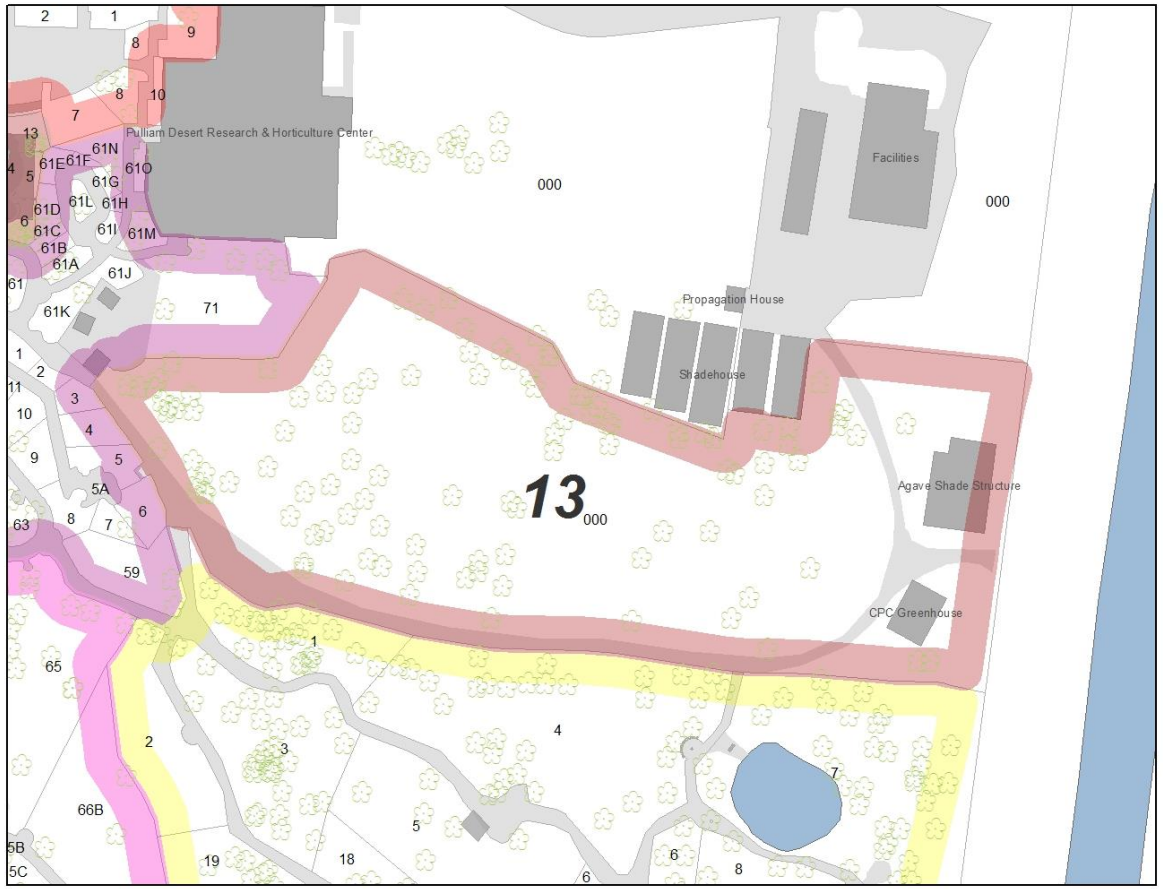
Pruning Plan

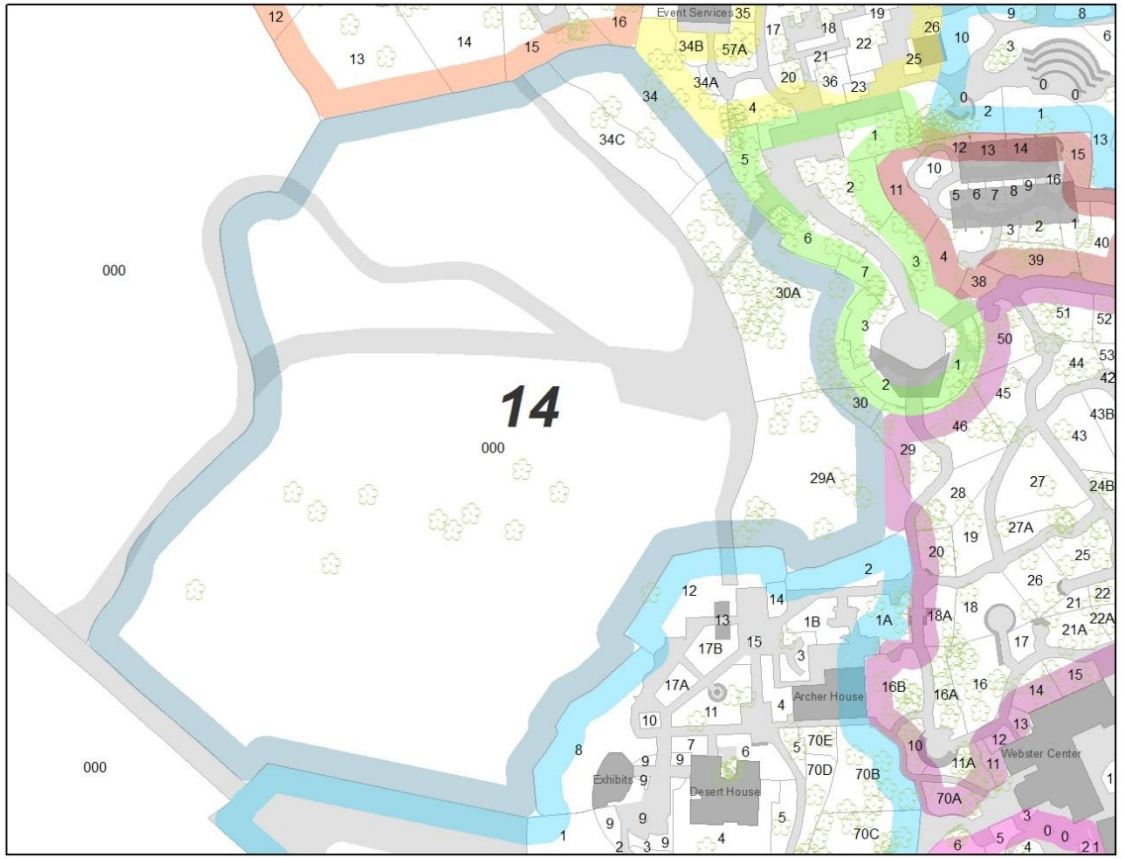


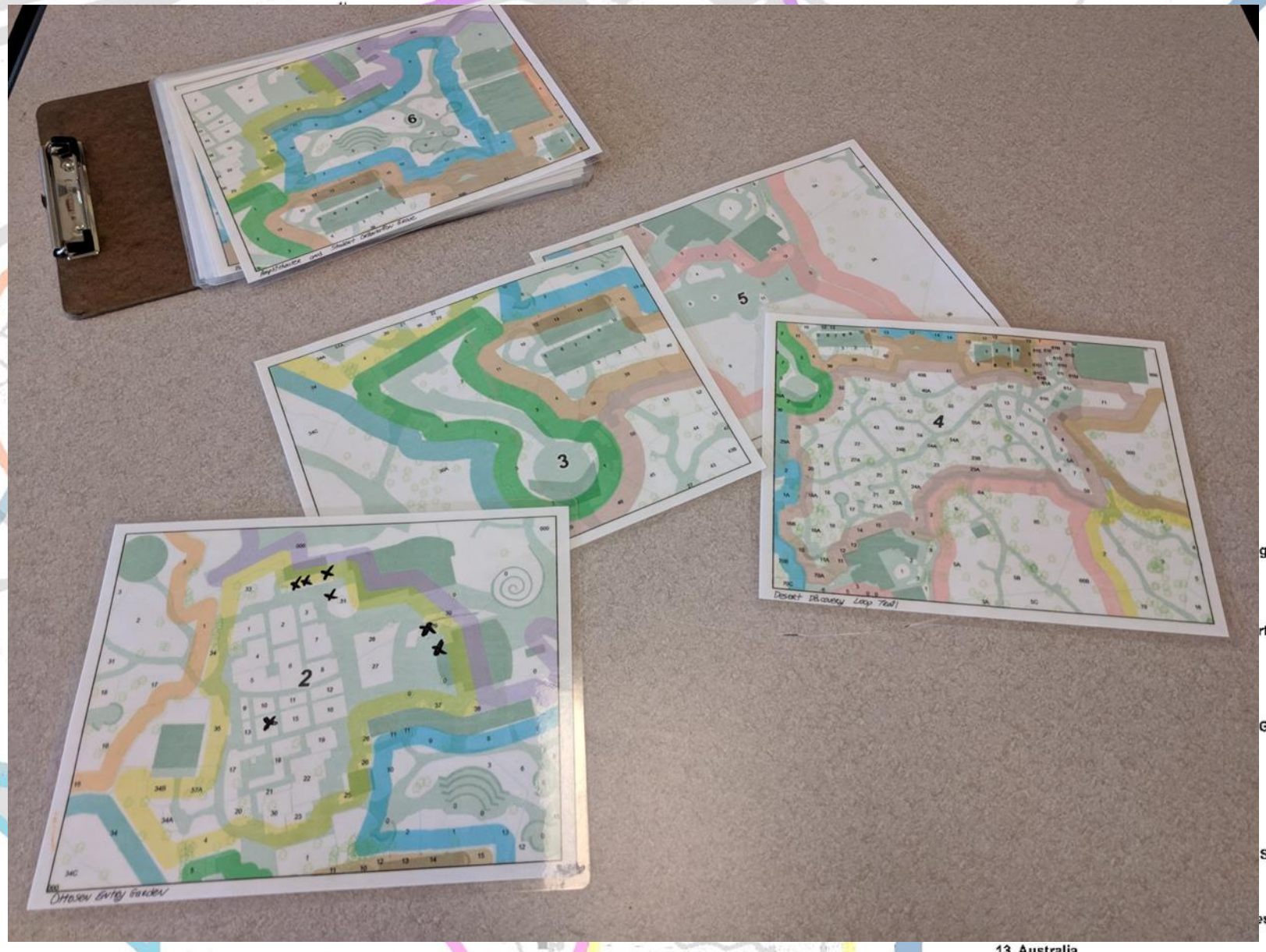




Pruning Plan







g Entry Arbor,

rtal

Grove

Stardust Plaza

esert Loop Trail

13. Australia

14. African Grove

Structural Pruning and Risk Assessment

- Breaking the reactionary management cycle of the “tyranny of the urgent” and limited time/staff requires getting out ahead of pruning and tree care.
- Structural pruning while a tree is young will reduce pruning requirements, staff time, and injury to the tree.
- Performing a risk assessment keeps visitors safe and trees healthy. Preventive, corrective, or mitigation pruning can be built into pruning cycles.

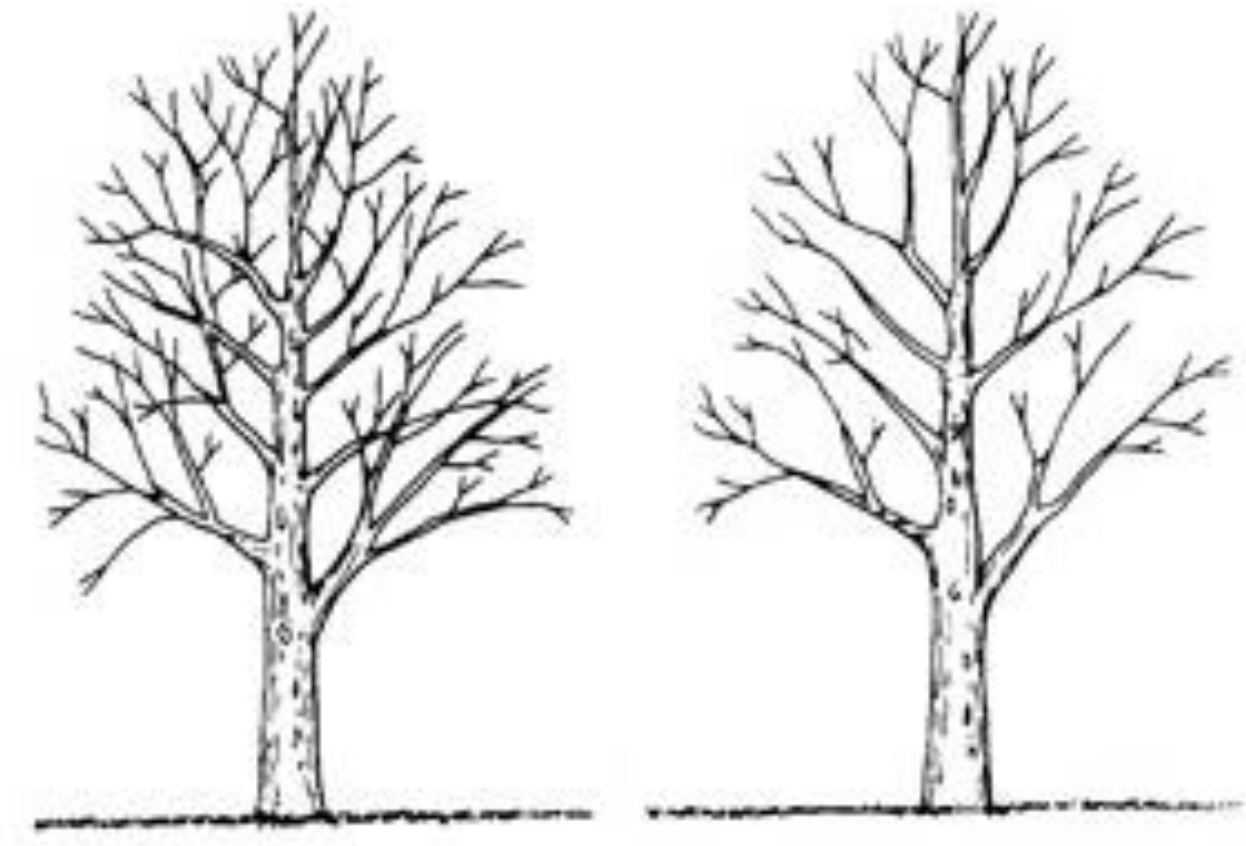
Structural pruning

262 trees that meet our definition of structural pruning

131 hours

3 weeks worth of work

26 hours



Risk Assessment

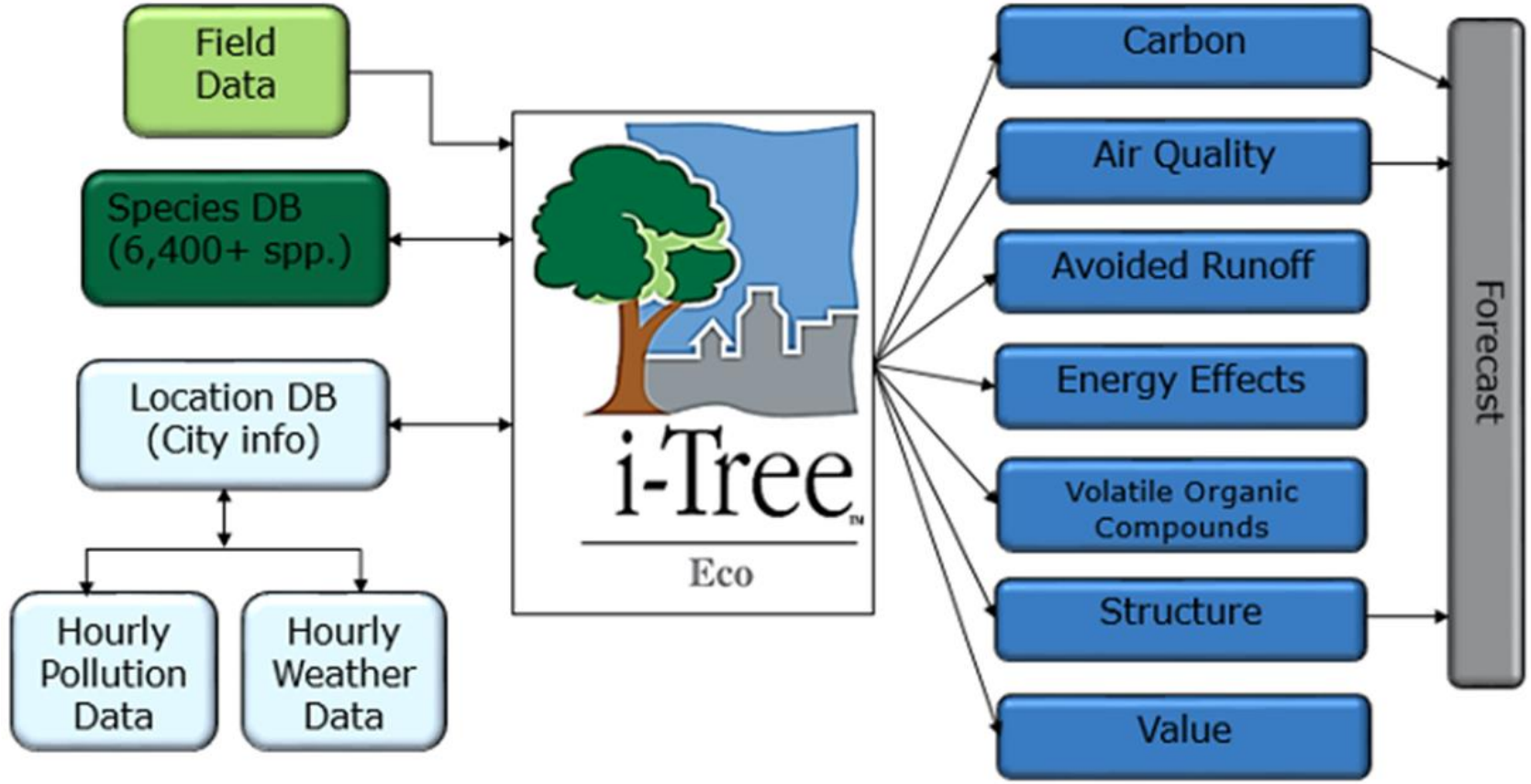
Tree Risk Assessment performed at two-year intervals

Mitigation pruning to reduce risk to acceptable level

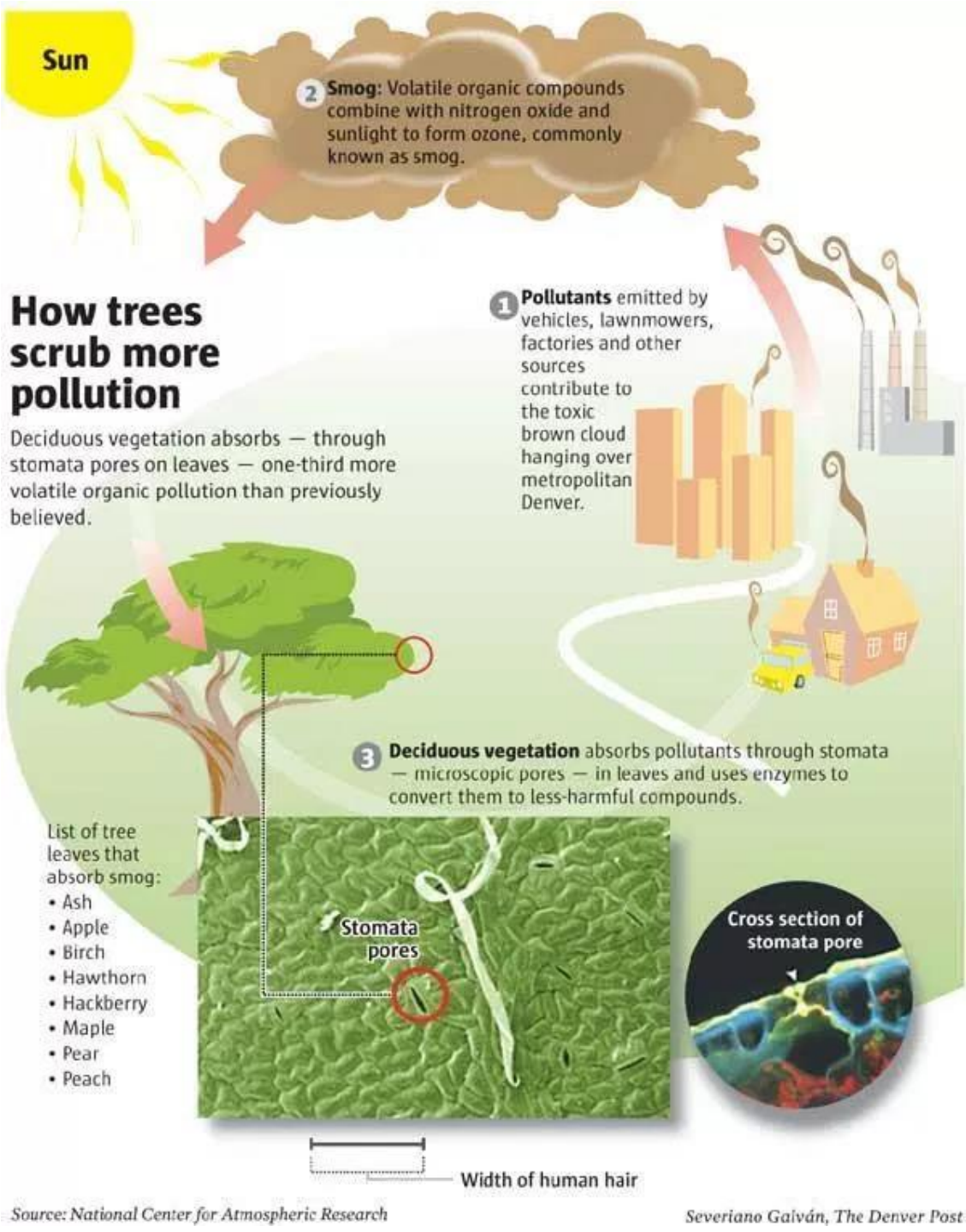
53 trees with structural defects

6 trees that warrant mitigation

iTree Surveys



iTree Survey



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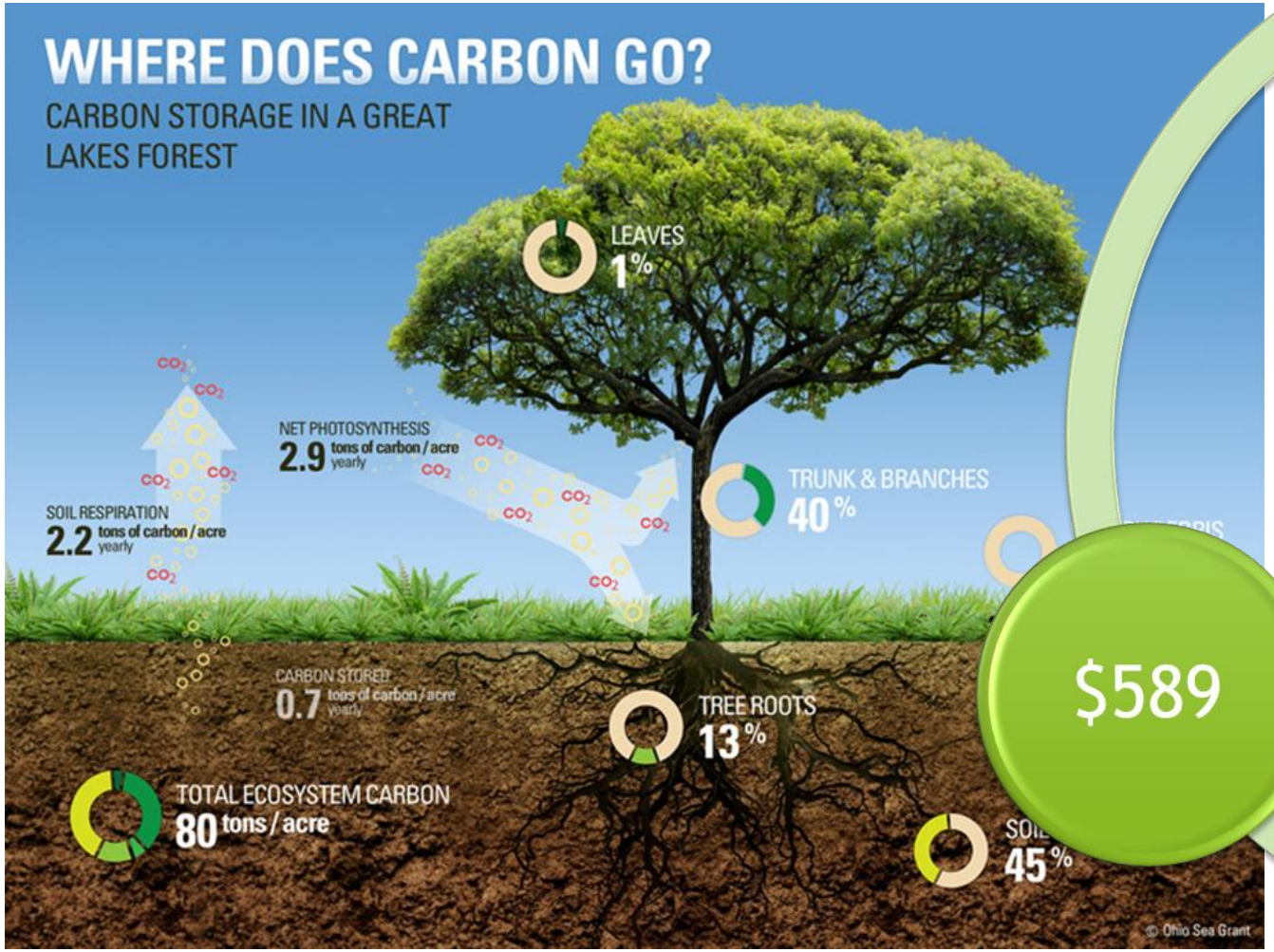


$3,830

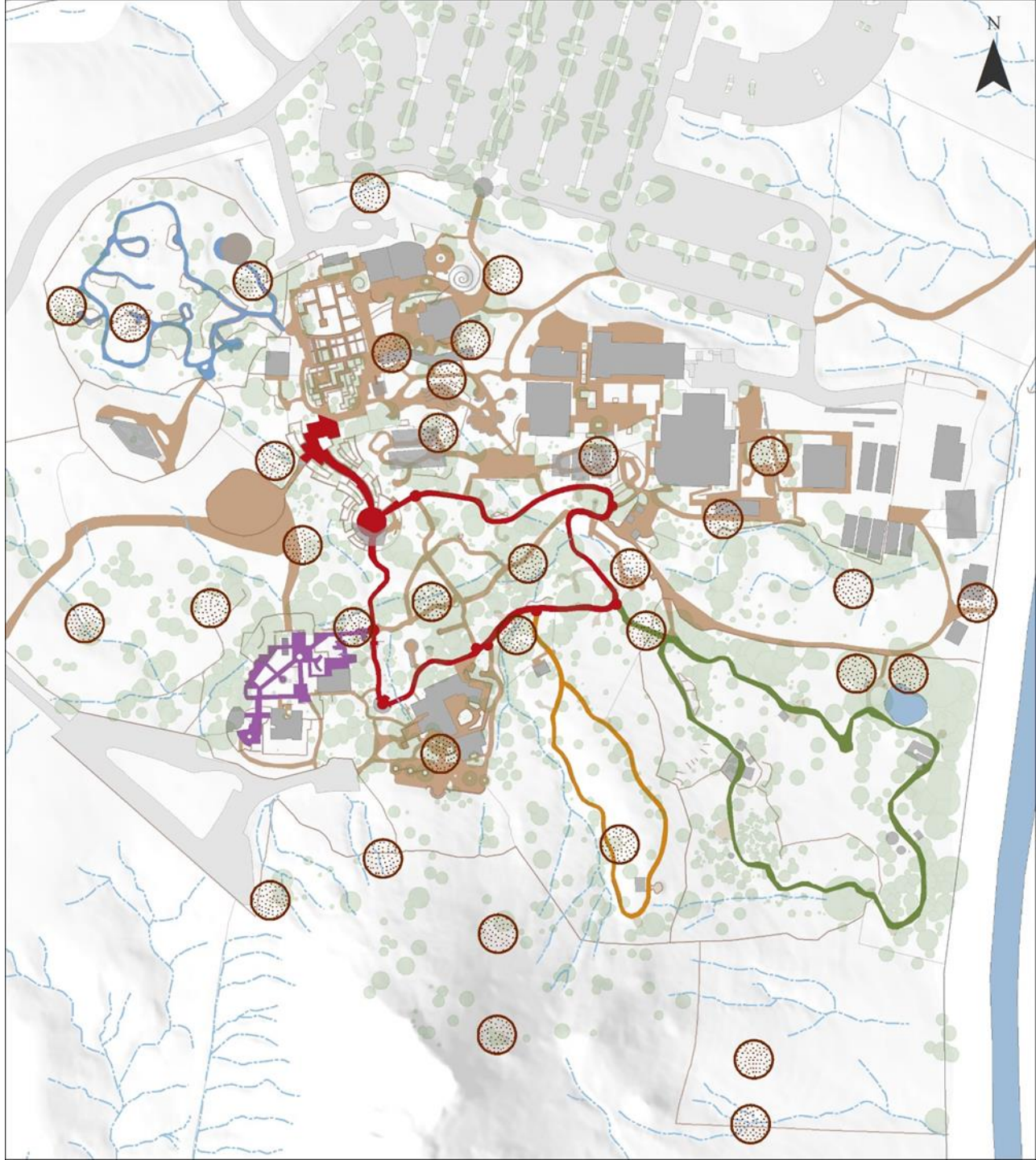
Ecological Benefits: $5,579

$589

$1,160

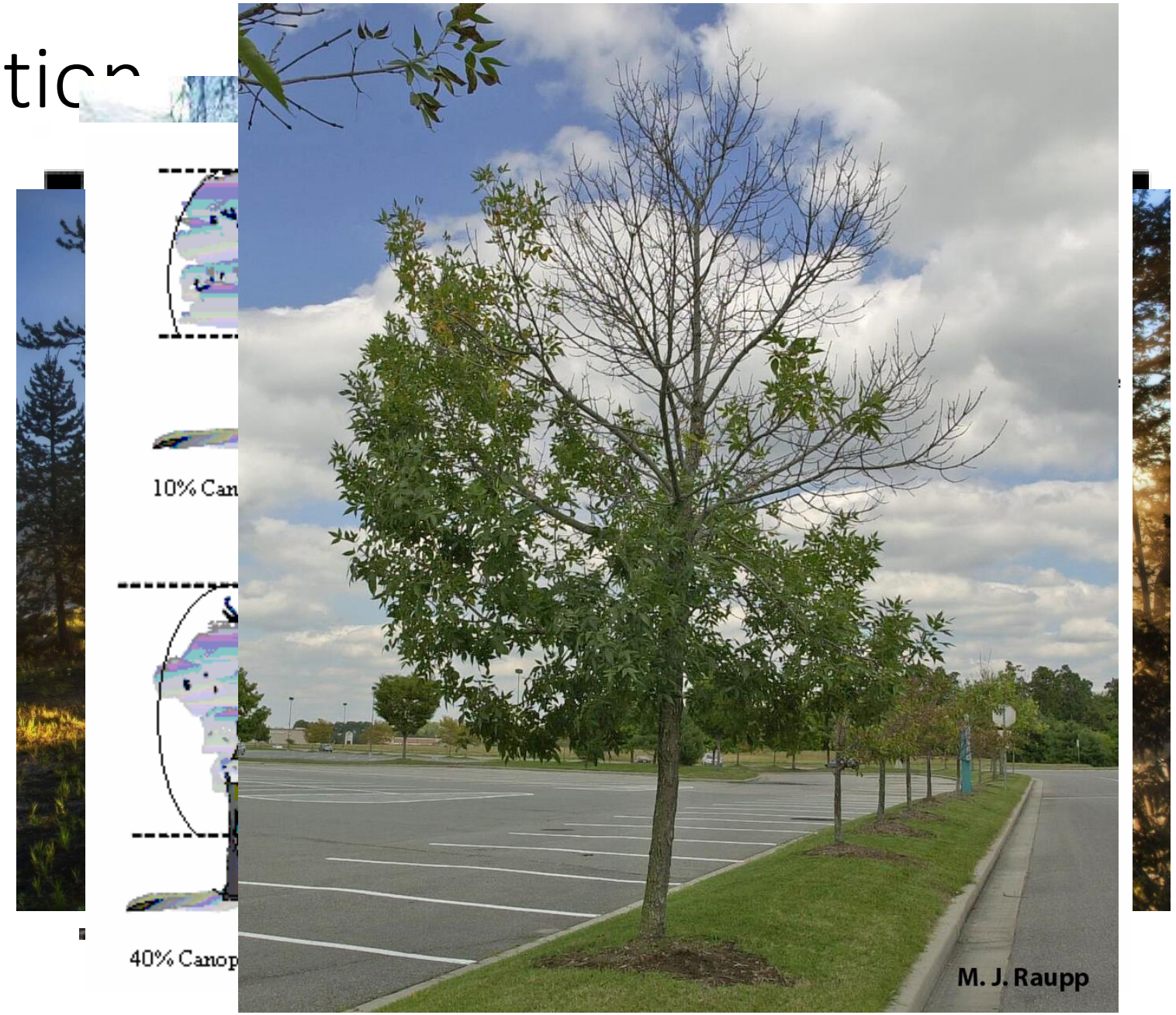
iTree:

- Determine sample strategy
    - i. complete
    - ii. Sample
    - iii. Stratified
- DBG iTree survey:
    - 34, 37 ft. radius plots,
    - non- stratified



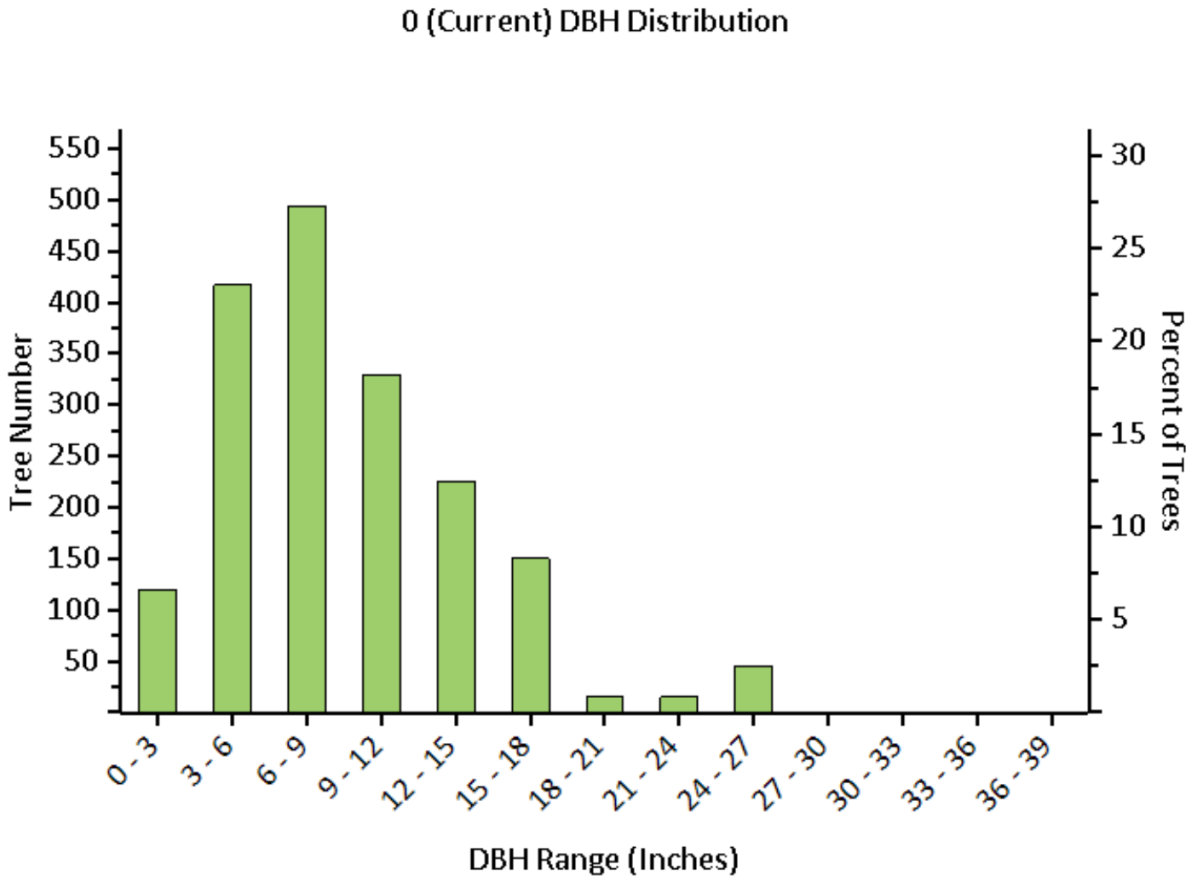
iTree: Data collection

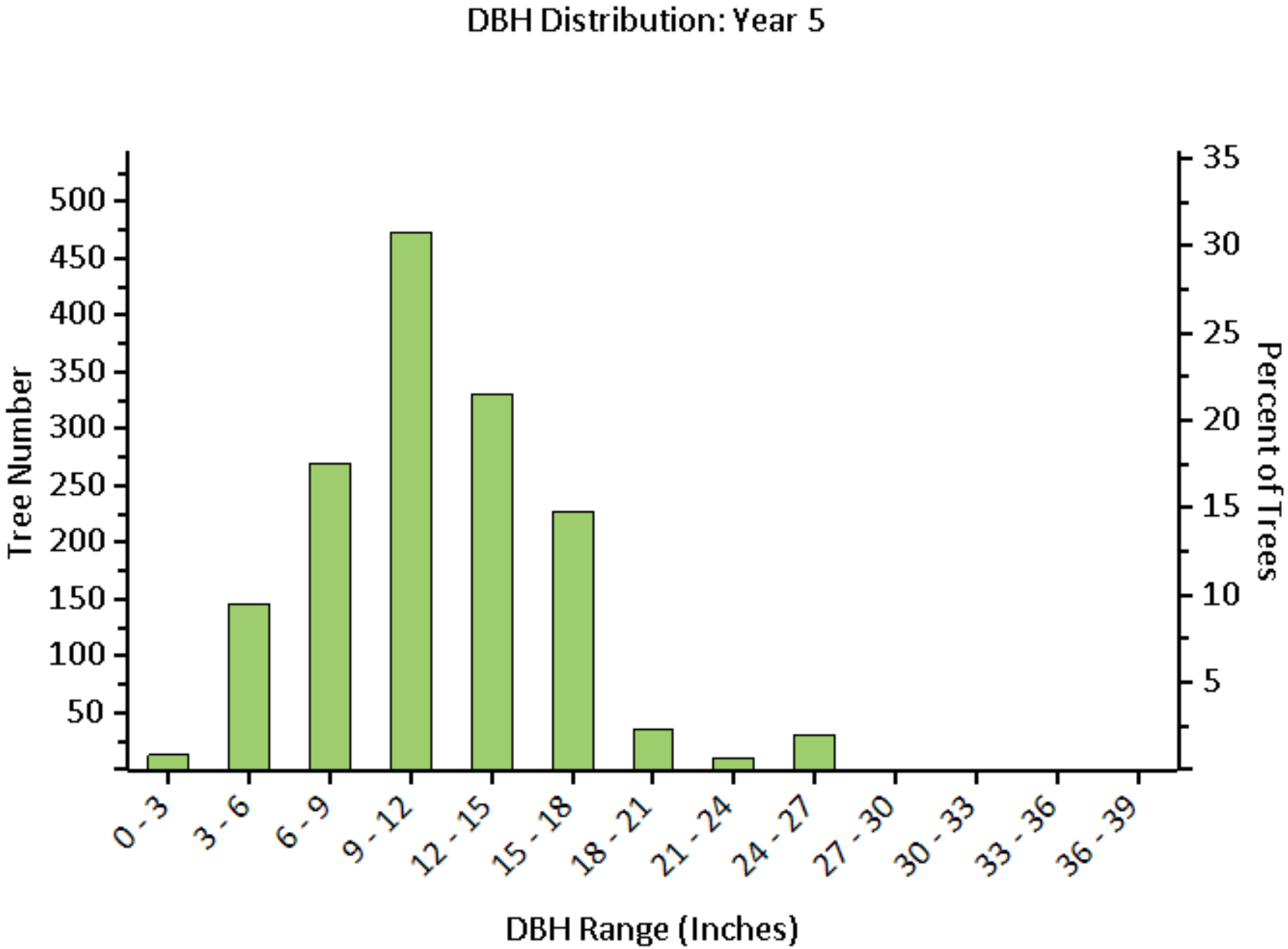
- Species
- DBH
- Height
- Canopy (N,S spread)
- Live Crown Ratio
- Crown Light Exposure
- Percent Crown Missing
- Crown Die-back

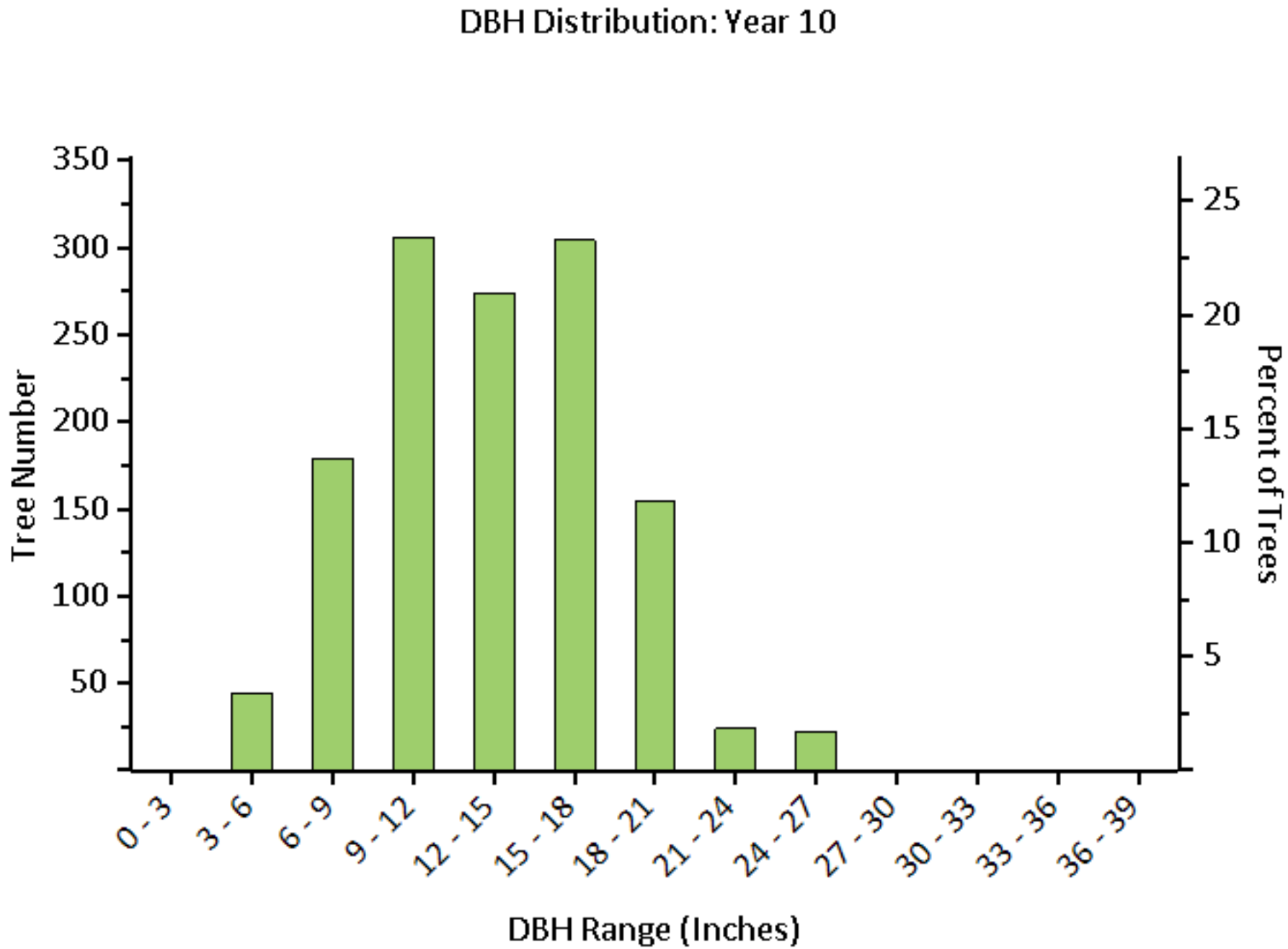


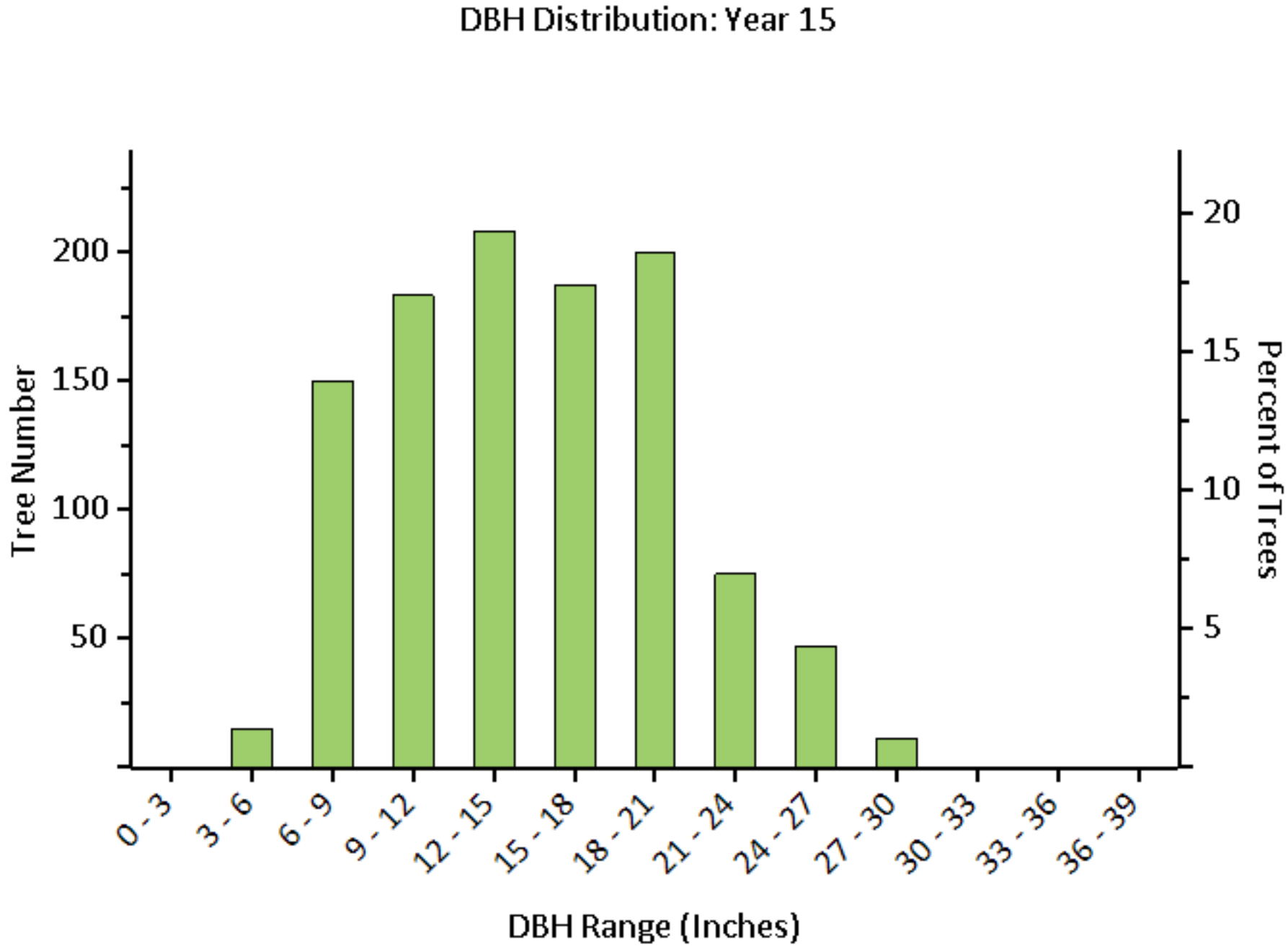
iTree: Forecasting

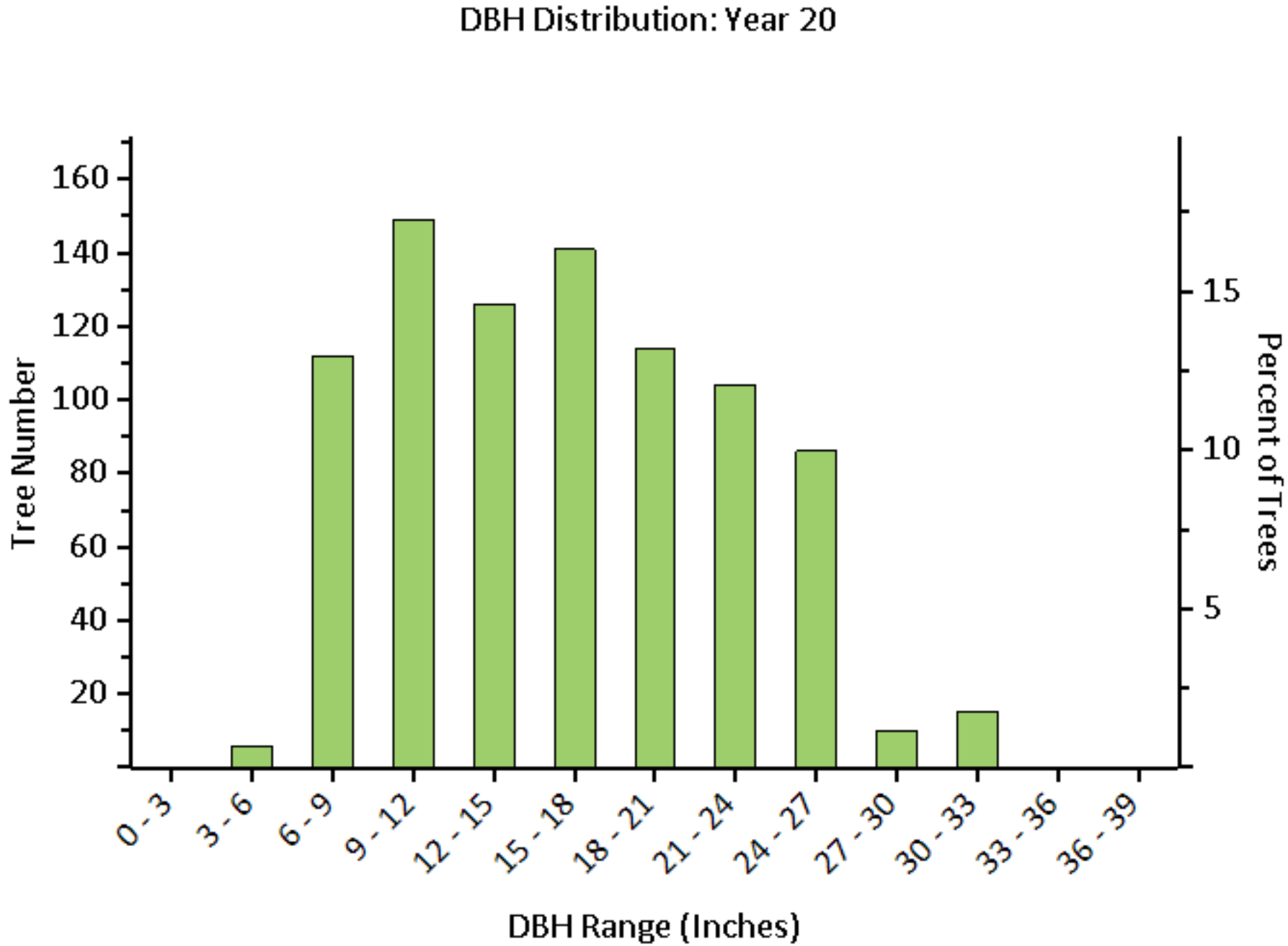
- Number of trees
- Looks are condition of the tree
- Diameter (age class estimate)
- Projects age class through time

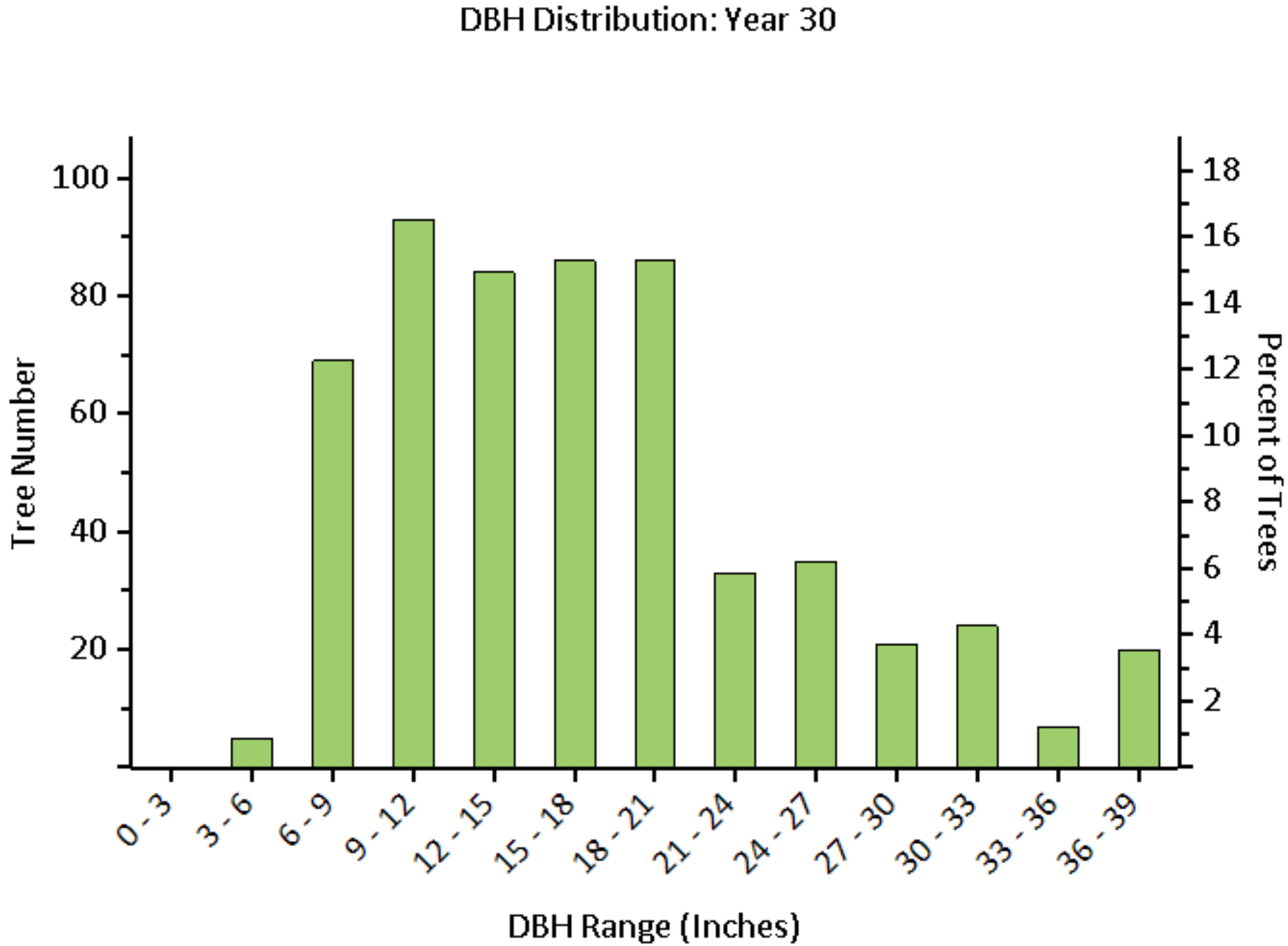



DBH Distribution: Year 5
Tree Number
500
450
400
350
300
250
200
150
100
50
Percent of Trees
35
30
25
20
15
10
5
0 - 3
3 - 6
6 - 9
9 - 12
12 - 15
15 - 18
18 - 21
21 - 24
24 - 27
27 - 30
30 - 33
33 - 36
36 - 39
DBH Range (Inches)

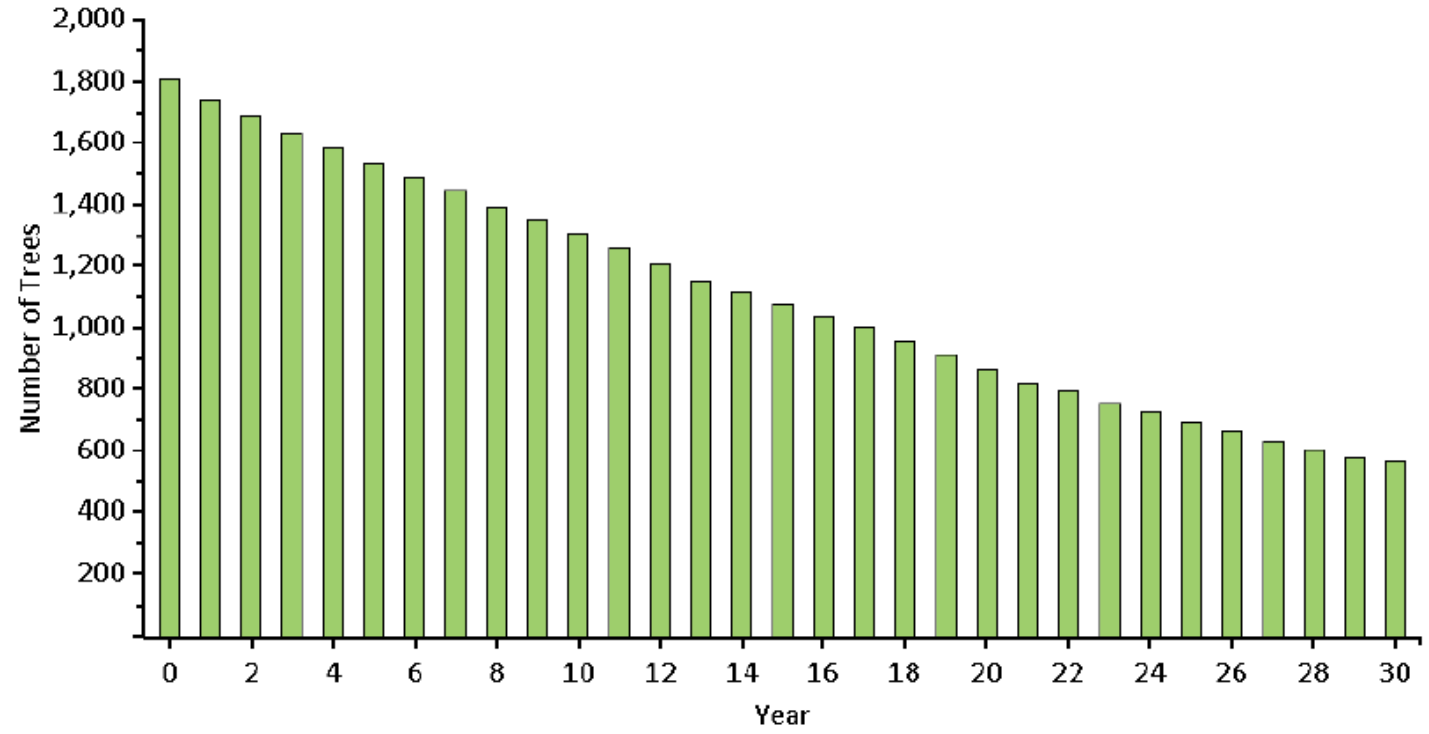

DBH Distribution: Year 10
Tree Number
350
300
250
200
150
100
50
Percent of Trees
25
20
15
10
5
0 - 3
3 - 6
6 - 9
9 - 12
12 - 15
15 - 18
18 - 21
21 - 24
24 - 27
27 - 30
30 - 33
33 - 36
36 - 39
DBH Range (Inches)


DBH Distribution: Year 15
Tree Number
200
150
100
50
20
15
10
5
Percent of Trees
0 - 3
3 - 6
6 - 9
9 - 12
12 - 15
15 - 18
18 - 21
21 - 24
24 - 27
27 - 30
30 - 33
33 - 36
36 - 39
DBH Range (Inches)


DBH Distribution: Year 20
Tree Number
160
140
120
100
80
60
40
20
Percent of Trees
15
10
5
0 - 3
3 - 6
6 - 9
9 - 12
12 - 15
15 - 18
18 - 21
21 - 24
24 - 27
27 - 30
30 - 33
33 - 36
36 - 39
DBH Range (Inches)


DBH Distribution: Year 30
Tree Number
Percent of Trees
100
80
60
40
20
18
16
14
12
10
8
6
4
2
0 - 3
3 - 6
6 - 9
9 - 12
12 - 15
15 - 18
18 - 21
21 - 24
24 - 27
27 - 30
30 - 33
33 - 36
36 - 39
DBH Range (Inches)

Mortality Curve



Year	Trees
2017	1,810
2022	1,538
2027	1,307
2032	1,076
2037	863
2042	691

Conclusion

Small gardens are tasked with large jobs, regardless of capacity or budgets.

Planning head is the only way to avoid falling behind.

Technology and managements strategies for tree collections lets managers and horticulturists understand the shape and scale of the collections they care for, and can quantify what time commitments are involved in their upkeep.

Trees are valuable in and of themselves, but they have both ecological and economic value as well.

With the environmental benefits trees provide to our community, they are one of the few botanical, structural features of our gardens that appreciate with time.

Work Cited

City of Phoenix. (2010). Tree and Shade Master Plan. City of Phoenix. Phoenix, AZ. Retrieved from: https://www.phoenix.gov/parkssite/Documents/T%20and%20A%202010.pdf

Meixner, T.; Manning, A.; Stonestrom, D.; Allen, D.; Ajami, H.; Blasch, K.; Brookfield, A.; Casto, C.; Clark, J.; Gochis, D.; Flint, A.; Neff, K.; Niraula, R.; Scanlon, B.; Singha, K. and Walvoord, M. (2016). Implications of projected climate change for groundwater recharge in the western United States. *Journal of Hydrology*. 534: 124-138. Retrieved from: https://www.sciencedirect.com/science/article/pii/S0022169415009750

Nowak, D.; Greenfield, E.; Hoehn, R.; and Lapoint, E. (2013). Carbon storage and sequestration by tree in the urban and community areas of the United States. *Environmental Pollution*. 178: 229-236. Retrieved from: https://canopy.itreetools.org/resources/i-Tree_Canopy_Carbon_Storage_and_Sequestration.pdf