




National Urban Research & Extension Center



A role for urban Extension to enhance urban forest stewardship and climate resiliency

A case study of the Treebate
incentive

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Introduction

The USDA Forest Service recognizes urban forests as having significant benefit to the lives of Americans [1], but climate change may put these forests at risk. Now, the Inflation Reduction Act is putting more money than ever before into this critical green infrastructure [1]. Unprecedented funding comes with its own challenges, especially the capacity to direct dollars quickly and efficiently. Cities across the United States already recognize the importance of their urban forests and have been running tree planting programs to support urban forest growth for years. Here, we use a case study of one such program to examine how the Cooperative Extension System (Extension) [2] is perfectly positioned to help community-oriented urban forestry programs thrive.

Treebate

The Treebate program (City of Portland, Multnomah County, Oregon) offers a one-time, per-tree credit of up to \$50 to incentivize yard tree planting on single-family residential property [3]. The program was designed to link trees with stormwater in the minds of utility customers by setting a range of maximum credit potentials based on mature tree size categories (fruit tree, small-, medium-, and large-maturing). These categories are meant to reflect an increasing volume of rain managed with increasing mature tree size. Staff also seek to encourage evergreen and native tree planting for additional stormwater management potential and broader watershed health goals. These characteristics, however, are not currently built into the potential credit value. Treebate credits are issued as adjustments directly to a ratepayers' utility bill.

From 2010 to 2022, the city issued 3,733 Treebate credits totaling nearly \$83,000 in reduced revenue and a staff investment of only 0.15 full-time equivalent (FTE) annually. Participants invested more than \$426,000 in the material cost of trees credited. Treebate does not maintain an eligible species list, and participants planted a broad diversity of trees, representing at least 243 species and 97 genera. However, despite the larger potential credit size for larger-maturing trees, only 8% of trees fell into the large-maturing category (Table 1). Evergreen trees accounted for 25% of Treebates issued, and native species for 15%.

It is clear from the mismatch between program incentive and customer preference that the Treebate program is not influencing homeowner choice to the extent that its design intended. At the same time, the autonomy to select and care for a tree is an important scale at which social justice is realized in the urban forest [4]. For this reason, program staff would like to better understand avenues for influencing tree choice without drastically reducing it. Additionally, Treebate is premised on the idea that a tree will survive for decades in the landscape to reach a maximum size and provide a maximum range of ecosystem service benefits. Climate change reduces the validity of this assumption.

In this study, we sought to 1) better understand the motives and needs of former Treebate participants, and 2) assess the vulnerability of the trees planted to climate change. With funding for the incentive but few staff resources, Treebate provides a case study in how technical and educational expertise of Extension could serve to improve urban forest stewardship and climate resiliency in a municipal planting program while understanding the interests and respecting the autonomy of diverse participants.

Table 1: Distribution of Treebate trees, rebate size, tree cost, and rebate ratio by mature size category.

	TREES CREDITED (% TOTAL)	MEDIAN REBATE (\$)	MEDIAN TREE COST (\$)	RATIO REBATE:COST
MATURE SIZE CATEGORY				
LARGE	8%	\$30.00	\$70.00	0.44
MEDIUM	20%	\$25.00	\$75.00	0.36
SMALL	69%	\$15.00	\$74.99	0.30
UNKNOWN	3%	\$15.00	\$40.00	0.44
FUNCTIONAL CATEGORY				
BROADLEAF EVERGREEN	3%	\$19.99	\$74.99	0.29
CONIFEROUS EVERGREEN	22%	\$20.00	\$79.50	0.33
DECIDUOUS	74%	\$17.49	\$69.99	0.32
UNKNOWN	<1%	\$36.25	\$75.00	0.44
PROVENANCE				
NATIVE	15%	\$20.13	\$56.11	0.42
NON-NATIVE	84%	\$16.47	\$75.00	0.31
UNKNOWN	1%	\$24.00	\$49.99	0.46

Participant Survey

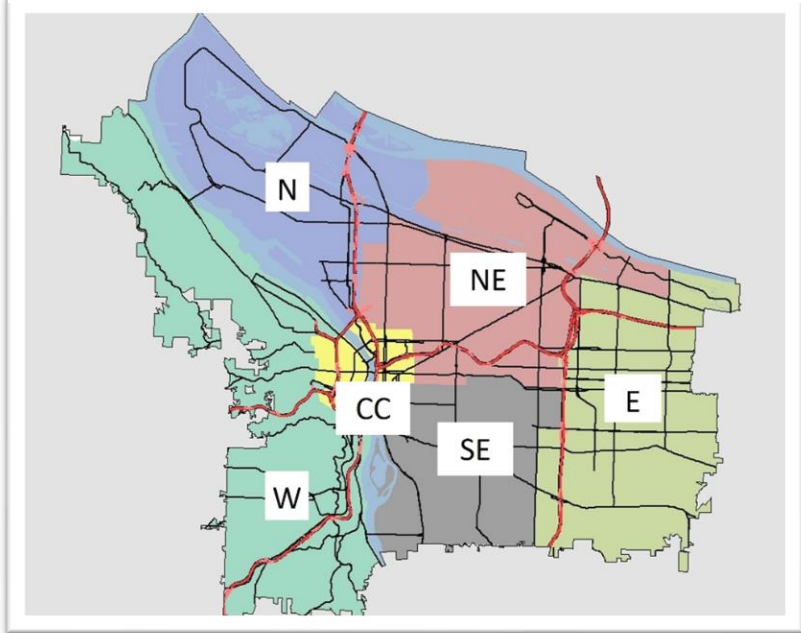
Treebate is a relatively hands-off program: the customer chooses, purchases, plants, and cares for their trees with little intervention from program staff beyond a list of eligibility requirements. As such, Treebate offers us a window into the interests and needs of independent-minded homeowners. We wanted to learn more from these homeowners about how they chose their tree, how they care for their tree now, and what kind of additional programming they would be interested in to support them in tree stewardship.

Methods

We sent a single postcard invitation to all 1,728 Treebate-participating tax lots with deliverable address points as of September 2023. Instructions asked for the household member who participated in Treebate to take the survey, or, if not available, the household member who was most involved currently in tree care. We employed skip logic to direct participants based on their answers. The survey was open from approximately September 18 to October 20 and a \$5 e-gift card was offered for survey completion.

A short demographic section included homeownership status, income in \$10,000 segments, race and ethnicity based on the American Community Survey categories, and geographic location, anonymized over clustered census tracts (Figure 1). Demographic questions were not required to complete the survey.

Figure 1: Clustered census tracts for Treebate participant survey, Portland, OR.



Results

We received 179 surveys from former Treebate participants, a response rate of 10%. An additional 74 surveys from individuals who did not themselves participate in Treebate, but currently reside at Treebate-participating tax lots were also recorded and analyzed separately. Here we focus on the responses of former participants.

Demographics

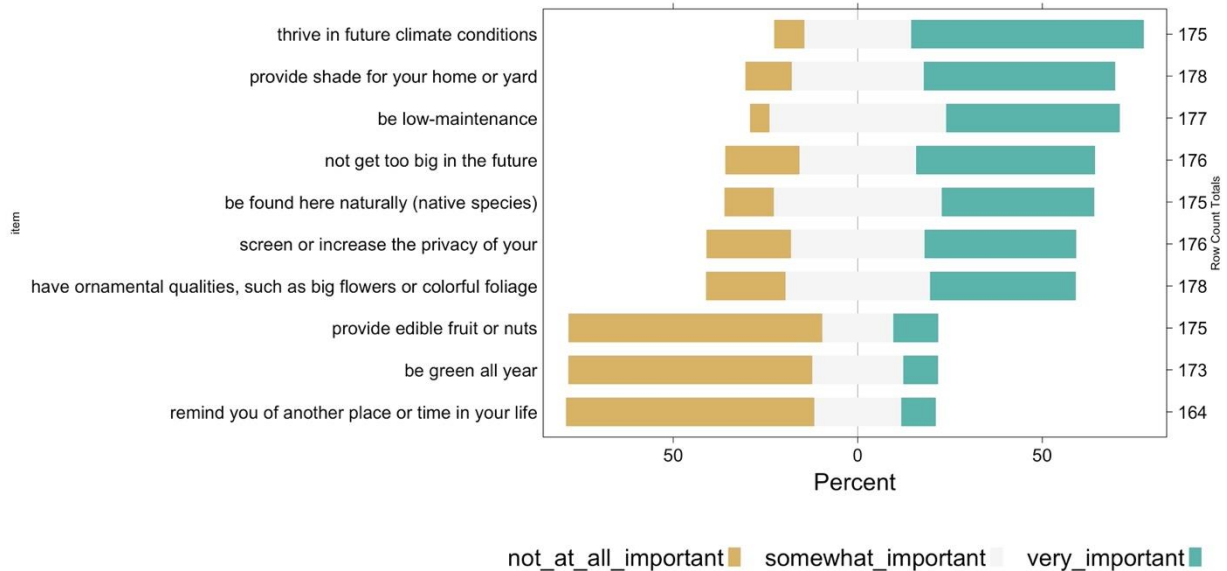
The geographic distribution of survey respondents was representative of all Treebate credits (X-squared = 35, df = 30, p-value = 0.2426). Respondents were 99% homeowners (n=157) and their racial distribution was representative of Multnomah County overall (X-squared = 28, df = 24, p-value = 0.3) [5]. Respondents were reflective of a range of incomes, from less than \$10,000 to more than \$250,000, with a median income category of \$90,000-\$100,000 (n = 130). The 2022 Median Household Income for Portland was \$81,119 [6].

Tree Selection Factors

Respondents rated a wide variety of characteristics as important in their selection, including thriving in future climate, providing shade, not getting too big, being low maintenance, being found naturally in the region (native), and increasing the privacy of their yard (Figure 2; Table 2). Less important were characteristics such as the provision of edible fruits and nuts, being green all year, and reminding them of another place or time in their lives.

Figure 2: Distribution of tree characteristics considered when choosing a tree. Not all characteristics were considered equally (row count total).

How important was it to choose a tree that would...



HOW IMPORTANT WAS IT TO CHOOSE A TREE THAT WOULD...

AVERAGE RANK (1 LOW - 3 HIGH)

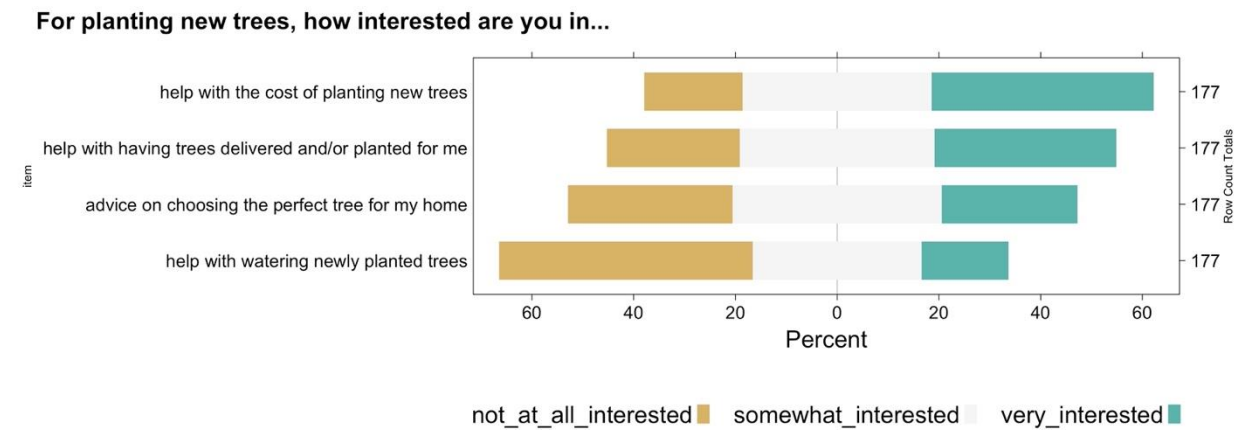
...THRIVE IN FUTURE CLIMATE	2.6
...PROVIDE SHADE FOR YOUR HOME OR YARD	2.4
...BE LOW-MAINTENANCE	2.4
...NOT GET TOO BIG	2.3
...BE FOUND HERE NATURALLY (NATIVE SPECIES)	2.3
...SCREEN OR INCREASE THE PRIVACY OF YOUR YARD	2.2
...HAVE ORNAMENTAL QUALITIES, SUCH AS BIG FLOWERS OR COLORFUL FOLIAGE	2.2
...PROVIDE EDIBLE FRUIT OR NUTS	1.5
...BE GREEN ALL YEAR	1.5
...REMIND YOU OF ANOTHER PLACE OR TIME IN YOUR LIFE	1.6

Planting new trees in the future

We asked respondents what kind of assistance they would be interested in if they were to plant another tree in the future. Help with the cost of planting and help with the physical aspects of planting (delivery,

planting) were the most desired programs (*Figure 3*; Dunn’s pairwise $p = 0.1$). Participants were somewhat less interested in getting advice (Dunn’s pairwise with cost $p = 0.001$, Dunn’s pairwise with delivery/planting $p = 0.1$). Help with watering newly planted trees was the program type of least interest.

Figure 3: Survey respondent interest in assistance for new tree planting.



FOR PLANTING NEW TREES, HOW INTERESTED ARE YOU IN...	AVERAGE RANK (1 LOW – 3 HIGH)
...HELP WITH THE COST OF PLANTING NEW TREES	2.2
...HELP WITH HAVING TREES DELIVERED AND/OR PLANTED FOR ME	2.1
...ADVICE ON CHOOSING THE PERFECT TREE FOR MY HOME	1.9
...HELP WITH WATERING NEWLY PLANTED TREES	1.7

Caring for existing trees

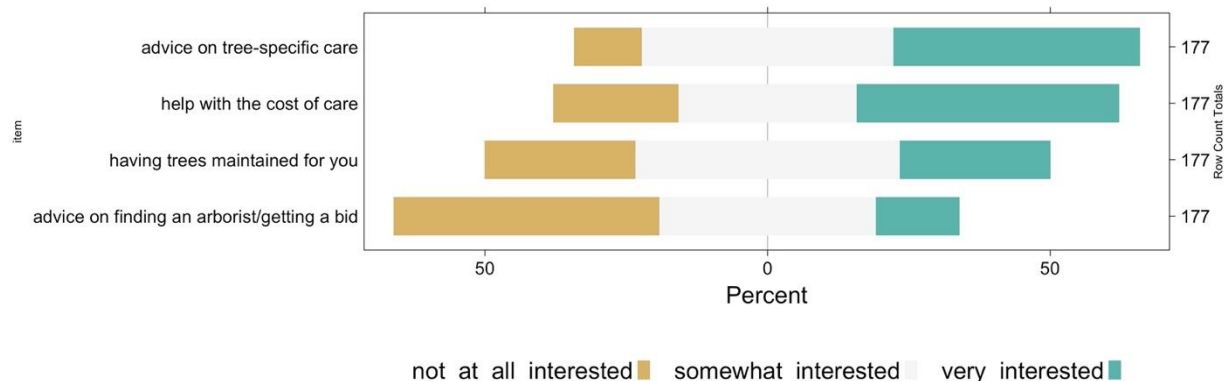
Sixty percent of survey respondents reported that they provide the only care their trees receive and approximately 28% hire a professional once in a while ($n=179$). Only 3% hire a professional tree care provider on a regular basis.

When asked about their interest in assistance with mature tree care, tree-specific advice and help with the cost of maintenance were of significantly more interest to respondents than having their trees maintained on their behalf or in receiving advice on contracting with a private tree care professional (*Figure 4*; Dunn’s pairwise p -values <0.01). However, only 19% of respondents chose themselves as a preferred source of tree care ($n=179$), indicating a mismatch between preferred and actual source of maintenance. Assistance with the cost of care was of significantly more interest to participants who identified as a race or ethnicity other than white-alone¹ ($p = 0.02$).

¹ White-alone indicates respondents who identified as white only, without an additional selection for race or the ethnicity category Hispanic or Latino/a

Figure 4: Survey respondent interest in assistance for mature tree care.

For mature (existing) trees, how interested are you in...



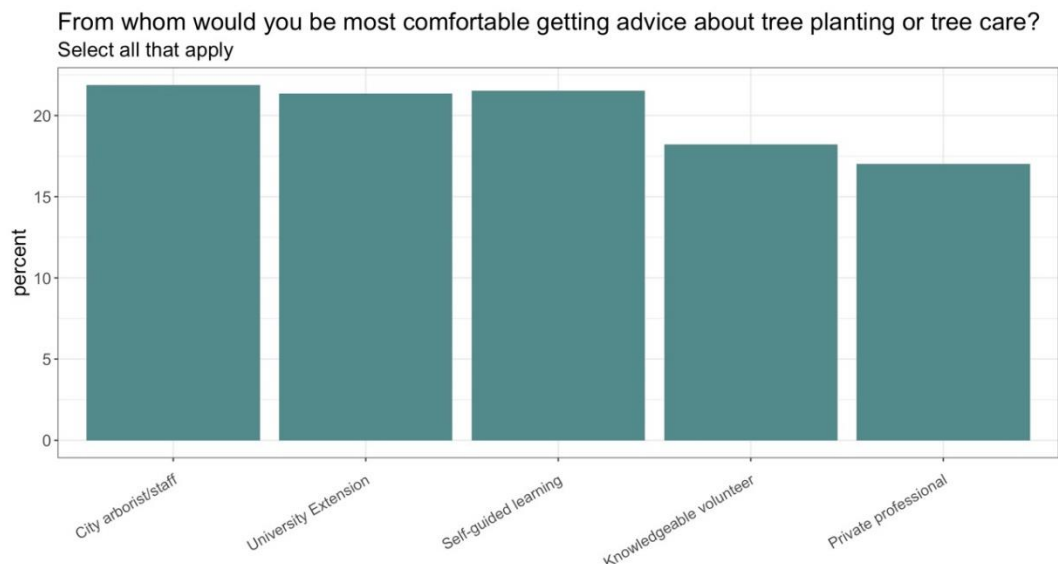
FORE MATURE (EXISTING) TREES, HOW INTERESTED ARE YOU IN...

AVERAGE RANK (1 LOW – 3 HIGH)

...ADVICE ON TREE SPECIFIC CARE	2.2
...HELP WITH THE COST OF CARE	2.1
...HAVING TREES MAINTAINED FOR YOU	1.9
...ADVICE ON FINDING AN ARBORIST/GETTING A BID	1.7

For sources of advice on tree planting and care, respondents were asked to consider City staff, Extension staff, knowledgeable volunteers, private professionals, and self-guided learning from vetted sources, and select those that they were most comfortable with. City staff, Extension staff and self-guided learning were selected slightly more frequently than knowledgeable volunteers or private professionals, but this difference was not statistically significant (Figure 5). The most popular selection combination was all four, with 29% of participants making this selection.

Figure 5: Preferred sources of advice for tree planting or tree care.

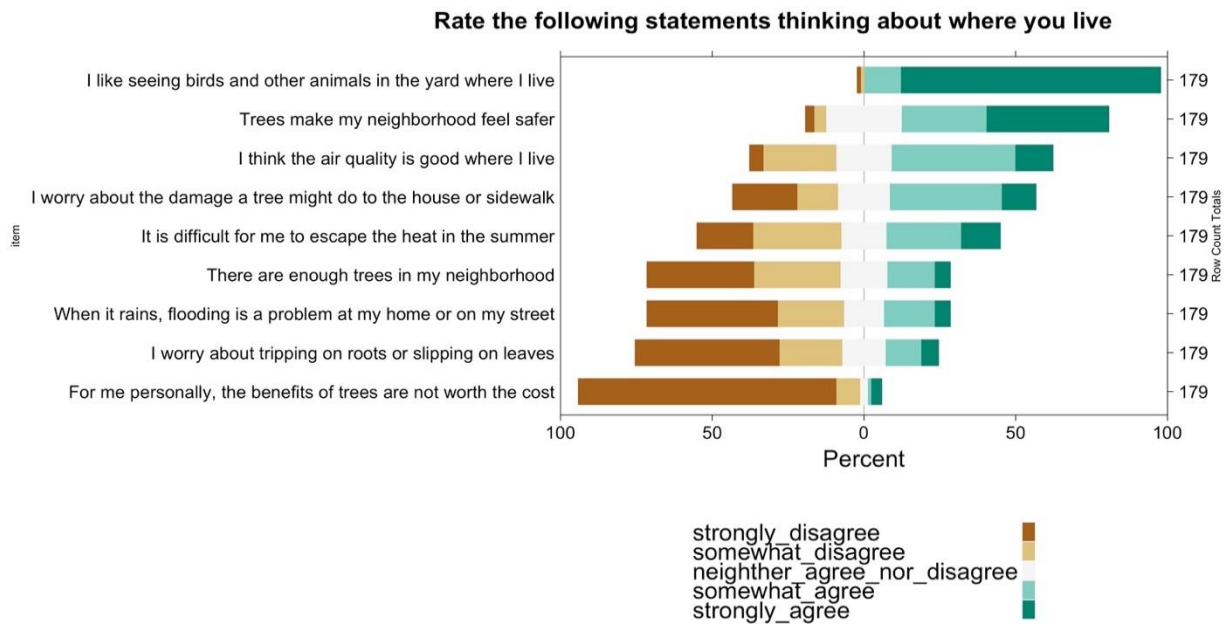


Perceptions of the immediate environment

Finally, we asked respondents to rank their agreement with statements about their local environment on a five-point scale from “strongly disagree” to “strongly agree.” These values give insight into tree characteristic preferences as well as values that might be emphasized when thinking about programming for tree planting, tree care, and future climate.

Respondents nearly universally like to see birds and other animals in their yards (*Figure 6*) and strongly agree that trees make their neighborhoods feel safer. Respondents strongly disagreed with the idea that trees are not worth the cost. They also generally disagreed that there are enough trees in their neighborhood. Respondents were split on the risk of damage that trees pose to homes or sidewalks.

Figure 6: Distribution of level of agreement with statements about survey respondents' immediate environment.



STATEMENT

AVERAGE RANK (1 LOW - 5 HIGH)

I LIKE SEEING BIRDS AND OTHER ANIMALS IN THE YARD WHERE I LIVE	4.8
TREES MAKE MY NEIGHBORHOOD FEEL SAFER	4.0
I THINK THE AIR QUALITY IS GOOD WHERE I LIVE	3.3
I WORRY ABOUT THE DAMAGE A TREE MIGHT DO TO THE HOUSE OR SIDEWALK	3.0
IT IS DIFFICULT FOR ME TO ESCAPE THE HEAT IN THE SUMMER	2.9
THERE ARE ENOUGH TREES IN MY NEIGHBORHOOD	2.3
WHEN IT RAINS, FLOODING IS A PROBLEM AT MY HOME OR ON MY STREET	2.2
I WORRY ABOUT TRIPPING ON ROOTS OR SLIPPING ON LEAVES	2.1
FOR ME PERSONALLY, THE BENEFITS OF TREES ARE NOT WORTH THE COST	1.3

Discussion

Survey responses from former Treebate participants suggest a positive environmental ethic and recognition of the benefits that trees provide. Property owners are hands-on with the tree care on their property, whether for preference or other reasons. Despite the sentiment that trees are worth the cost, cost is likely the largest driver here. Help with the cost of tree planting and tree care were the most popular assistance types. In addition, property owners did not feel they needed help selecting an arborist and largely trusted private professionals as much as any other trained or vetted source. Property owners are split on how much they worry about the damage that trees can do.

Most property owners do not value “evergreen” as a characteristic of their trees and are less likely to experience problems related to the rain. Stormwater management, then, is unlikely to be a strongly valued outcome. Other benefits of evergreens such as provision of habitat and privacy may be stronger values to emphasize. The lack of interest in evergreens is especially notable as many of the large native trees of the region are evergreen conifers.

Notably, property owners felt that it was very important to choose trees that would thrive in a future climate. If the goal is to maximize ecosystem services in the long-term, then tree choice is important for program success. In the next section, we’ll look at how trees planted for Treebate might fare with climate change.

Species selection and future climate

Over the next 60 years, the climate in Portland, OR is forecast to become more like the suburbs of its southern neighbor, Sacramento, CA [7]. Portland also shares a USDA climate zone [8] with its more northern neighbor, Seattle, WA. In the absence of a Willamette Valley-specific vulnerability assessment, we compared the Treebate species list with the Water Use Classification of Landscape Species [9] and the Puget Sound Region Tree Species Vulnerability assessment [10].

Method & Results

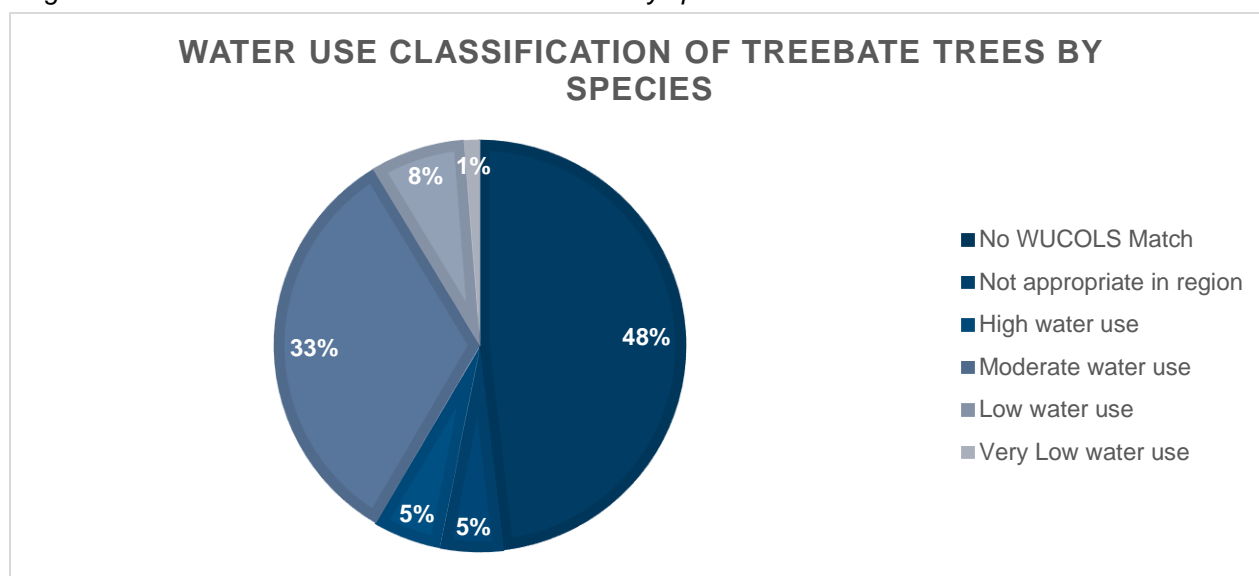
Water Use Classification of Landscape Species

The Water Use Classification of Landscape Species (WUCOLS) is a product of the California Center for Urban Horticulture. It provides an estimate for the irrigation needs of landscape plants by region [11]. The estimate is given as a percentage of a reference evapotranspiration (ET_0) for a cool season grass, commonly derived from weather data. The water use estimation is adequate to maintain a plant in good condition and assumes full sun and no connection to groundwater. The rating does not consider environmental modifiers specific to urban conditions. For more detail, the reader is invited to visit WUCOLS excellent user manual [11].

To compare Treebate species with WUCOLS, we sorted by Region 2 (Sacramento) and then reduced the list to include trees and arborescent shrubs only. We created a new list that corrected for differences in nomenclature and matched the WUCOLS list against Treebate species. Treebate records without adequate information to assign a botanical name were excluded.

We found a match for 52% of Treebate species, accounting for 2,798 trees (Figure 7). Five percent of Treebate species planted today are expected to be inappropriate for future climate. Another 38% are forecast to be moderate or high-water users, accounting for 71% of trees planted to date.

Figure 7: Water use classification of Treebate trees by species and count.



MATCH TYPE	REFERENCE WATER USE (% ET ₀)	SPECIES (N)	SPECIES (%)	TREES (N)	TREES (%)
WUCOLS MATCH		126	52%	2798	81%
NOT APPROPRIATE	NA	12	5%	140	4%
HIGH	70-90 %	13	5%	378	11%
MODERATE	40-60 %	80	33%	2081	60%
LOW	10-30 %	18	7%	160	5%
VERY LOW	<10 %	3	1%	39	1%
NO WUCOLS MATCH		117	48%	676	19%
TOTAL		243	100%	3474	100%

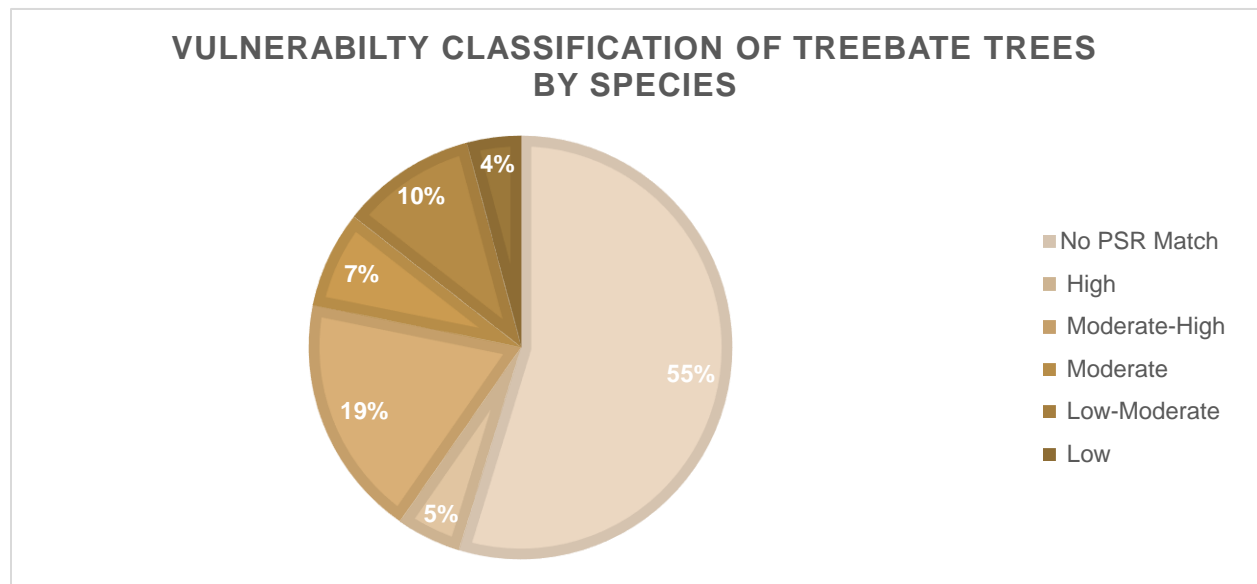
Puget Sound Region Tree Species Vulnerability

The Puget Sound Region Tree Species Vulnerability (PSR TSV) assessment is a product of the Climate Change Response Framework [10] [12]. PSR TSV derives a vulnerability score based on dozens of variables for both climate and adaptability, such as heat and hardiness zones, pests and disease, pollution tolerance, nursery production potential, and ease of planting and establishment. Final vulnerability scores are given as a matrixed score from low to high.

PSR TSV is listed by common name only. To compare this list with Treebate species, we needed to add a botanical name, which required an assumption of common name reference based on researcher knowledge of local trees. Treebate records without a botanical name were excluded to be consistent with the WUCOLS evaluation, so that we compared the same list of 243 species planted for Treebate credits.

We found a match for 45% of Treebate species, accounting for 2,440 trees (*Figure 8*). Twenty-four percent of Treebate species planted today are categorized as having high or moderate-high vulnerability to climate change. Only 14% of trees planted to date are considered to have low or low-moderate vulnerability.

Figure 8: Vulnerability classification of Treebate trees by species and count.



MATCH TYPE	SPECIES (N)	SPECIES (%)	TREES (N)	TREES (%)
PSR MATCH	110	45%	2440	70%
HIGH	12	5%	292	8%
MODERATE-HIGH	45	19%	992	29%
MODERATE	18	7%	364	10%
LOW-MODERATE	25	10%	631	18%
LOW	10	4%	161	5%
NO PSR MATCH	133	55%	1034	30%
TOTAL	243	100%	3474	100%

Discussion

Comparing the Treebate species list against WUCOLS Region 2 and the PSR TSV suggests that many trees being planted in urban residential yards today will not be thriving in the decades ahead. Both tools offer lists of trees that serve as starting points for shaping outreach materials, nursery stock reviews, and field monitoring programs. Given the uncertainty inherent in climate change, it makes sense to treat these tree suggestions as iterative while taking steps to collect observations and research specific to the Willamette Valley.

Conclusion

A role for urban Extension to enhance urban forest stewardship and climate resiliency

In the case of Treebate, we find homeowners with positive feelings about the environment willing to invest in the material cost of trees, but choosing trees that may not live to provide the benefits for which they are planted. How can Extension help remedy this situation?

A majority of property owners are very interested in tree care advice for the trees they have right now and already trust Extension and municipal staff as a source of information. Though they do not feel as strongly that they need help with species selection, it is clear that additional technical resources around choosing and/or helping to make available trees for future climate meets both property owner and municipal interests.

City programming commonly provides tree materials directly or helps with the cost of tree planting but fails to provide the sort of technical expertise that property owners want and need. Municipal staff are also not well situated to run growing trials themselves and could benefit from third-party coordination between municipalities. This kind of technical expertise and cross-jurisdiction coordination speak to the unique skills that Extension houses. Overall, our case study suggests several pathways for research, education, outreach, and intervention that are well-suited to the Extension profession.

Research and Development

Development of a climate-forward urban tree list for the Willamette Valley

A tree vulnerability assessment specific to the Willamette Valley is of great importance to both the municipal staff running tree planting programs and to the homeowners seeking to add ecosystem services to their property. An existing protocol [12] provides a template for such an assessment. Extension's role would be to coordinate the assessment, gather the local professionals necessary for subjective portions of the assessment, and make the results available to the public.

Groundwater resources

Irrigation for urban trees is an uncommon practice in Portland and the Pacific Northwest. Given the Mediterranean climate, we might assume most trees in the region are reliant on groundwater resources, but neither the extent of that reliance nor the impact of climate change on that resource is known. A better understanding of groundwater resources will help to guide appropriate tree selection for the future as well as determine when and where irrigation will be a best practice to retain valuable trees and maintain current levels of urban ecosystem services.

Monitoring, trials, and economic success of nursery growers

Municipal programs like Treebate provide access to a natural garden trial unfolding in thousands of residential yards. Extension can take the next step of working with municipal staff to track and share data across municipalities and further test promising species and varieties on land grant plots. Examples of this kind of work exist elsewhere [13].

Any tree list for a future climate is necessarily an iterative document with the need for regular feedback and updates. Extension staff with access to state agricultural experiment stations or other land grant property, and connections to the nursery industry are well positioned to trial trees that show promise and work with nursery growers to determine which trees can be made available in an economically viable manner. In Oregon, the Oregon Department of Forestry Urban and Community Forestry Program [14] would be a natural ally in helping to create the kind of collaborative growing arrangements between nurseries and smaller municipalities that could help to incentivize investment in climate-forward stock. An opportunity to fund this work may currently exist through grants made possible by the Inflation Reduction Act [14].

Training and Educational Partnerships

Educational partnerships

Educational partnership that are wrapped together with popular monetary incentives for tree planting could provide an avenue for property owners to ask questions and get access to the best available knowledge about tree care and the tree species that are just right for the microclimate of their yards as well as the broader direction of future climate. Partnership programming between city planting programs and Extension volunteers such as Master Gardeners [15] provides an existing avenue to direct extension resources to urban property owners. Extension could also provide technical expertise and training to non-profits engaged with residential landscaping choices. In Portland, example programs include Backyard Habitat [16] or Friends of Trees [17].

Continuing Education for Professionals

Certification programs for private professionals often require continuing education credits. Relevant examples include International Society of Arboriculture Certified Arborists [18] and, in Oregon, Registered

Landscape Architects [19]. Extension can provide CEU opportunities for professionals, helping to ensure that the professionals homeowners do hire are up to date on the best available information. An example of this currently in action is the Urban Forestry Today webinar hosted by University of Massachusetts Extension. These webinars are available to anyone, though they do not always contain material relevant or specific to west coast practitioners. Extension on the west coast can collaborate across existing platforms to ensure information relevant to west coast professionals is included. The Pacific Northwest Chapter of the International Society of Arboriculture is another venue for reaching local practitioners.

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