ECOSYSTEM SERVICES OF TCU CAMPUS TREES

Megan Boneck, Zoey Suasnovar, Gisela Pacheco, Audrey Haffner | Faculty Advisor: Brendan L. Lavy
Department of Environmental and Sustainability Sciences | Texas Christian University

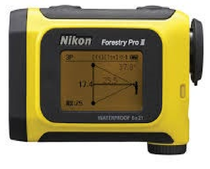
Introduction

Urban trees provide a variety of ecosystem services to an area that allows both humans and animals to thrive in their vicinity. The ecosystem services provided can be determined through specific aspects of a tree and their location in relation to buildings and ground cover. These ecosystem services include carbon storage and sequestration, air quality improvement, and avoided runoff. Texas Christian University (TCU) was designated a tree campus by the Arbor Day Foundation, signifying its commitment to planting and preserving trees under its care. Indeed, TCU has a history of tree care, evidenced by its active Campus Tree Committee, participation in both National and Texas Arbor Days, and an ongoing commitment to tree planting and preservation initiatives. Yet the extent to which campus trees provide benefits to the university community is unknown. The purpose of this research was to document the ecosystem services provided by the trees under TCU's management, including estimating their replacement costs.



Methods

We randomly plotted 200 points on TCU's campus (Figure 1). Each point had an area representing 1/10 of an acre radius around the focus. Within each area, we measured the diameter at breast height (DBH), species, health, height, and crown base of each tree. DBH was measured at 4.5 feet for the trees. All data was recorded in field notebooks and were later transferred to an electronic spreadsheet. We used a high accuracy GNSS unit to navigate to the centroids of each tree plot. We recorded images of all trees measured to serve as documentation so they could be revisited if needed in the future. We used Google Earth and Google Maps to determine the crown width and the light exposure for each tree. We then analysed our data using i-Tree Eco. i-Tree Eco is a software from developed by USDA Forest Service. It hosts a suite of tools used to estimate benefits of urban and rural forests. We used i-Tree Eco to generate estimates of the ecosystem services provided by TCU's campus trees, including carbon sequestration and storage, hydrological effects (such as runoff reduction, interception, and transpiration), and replacement value.

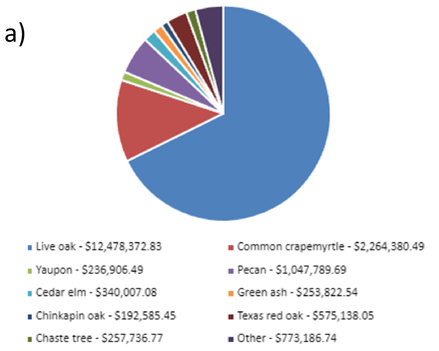


Data and Results

Table 1. Ecosystem services and replacements values of campus trees calculated via i-Tree Eco.

Species	*No. of Trees*	*Gross Carbon Sequestration (ton/yr)*	*Carbon Storage (ton)*	*Pollution Removal (ton/yr)*	*Avoided Runoff (gal/yr)*	*Replacement Value ($)*
Japanese maple	52	0.17	3.04	0.00	752.97	34,908.84
Pecan	157	5.53	140.20	0.13	44,108.89	1,047,789.69
Sugarberry	35	0.10	2.69	0.01	4,480.06	89,642.15
Desert willow	52	0.51	9.04	0.00	1,062.49	79,836.12
Flowering dogwood	52	0.32	4.83	0.00	1,345.39	46,131.20
Green ash	87	1.34	14.61	0.06	19,238.66	253,822.54
Chinese holly	70	0.70	9.49	0.00	764.70	89,973.22
Yaupon	122	1.14	25.09	0.02	8,068.03	236,906.49
Crape myrtle	471	2.57	399.11	0.07	24,698.73	2,264,380.49
Southern magnolia	52	0.54	2.67	0.00	1,345.96	50378.92
Chinaberry	52	1.04	24.14	0.01	2,528.88	133,326.56
Texas mulberry	17	0.02	27.53	0.01	3,280.65	74,246.24
Chinese pistache	52	1.46	14.35	0.03	9,171.74	116,954.96
Bur oak	17	0.19	1.69	0.00	1,278.04	28,754.31
Chinkapin oak	87	1.81	24.21	0.03	8,667.22	192,585.45
Texas red oak	87	4.36	72.99	0.15	49,871.19	575,138.05
Shumard oak	52	1.35	28.75	0.03	11,129.80	283,712.39
Live oak	1,099	49.54	1,923.15	1.17	393,166.63	12,478,372.83
Pond cypress	35	0.07	0.26	0.00	203.50	7,407.29
Cedar elm	192	3.69	32.76	0.07	22,115.50	340,007.08
Chinese elm	17	0.42	1.80	0.00	512.85	21,626.93
Chaste tree	52	0.48	28.21	0.01	2,750.28	257,736.77
Total	**2,913**	**77.33**	**2,790.60**	**1.81**	**610,542.17**	**18,703,638.52**

a)



b)

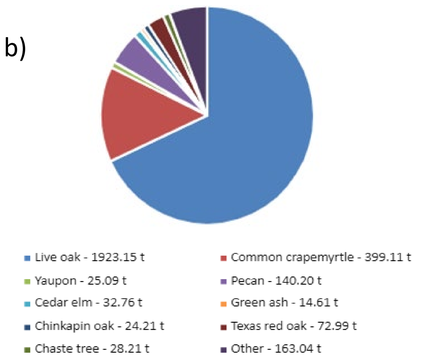


Figure 2. a) Total replacement value of TCU trees per species, and b) Total amount of Carbon stored per year by species.

Study Area

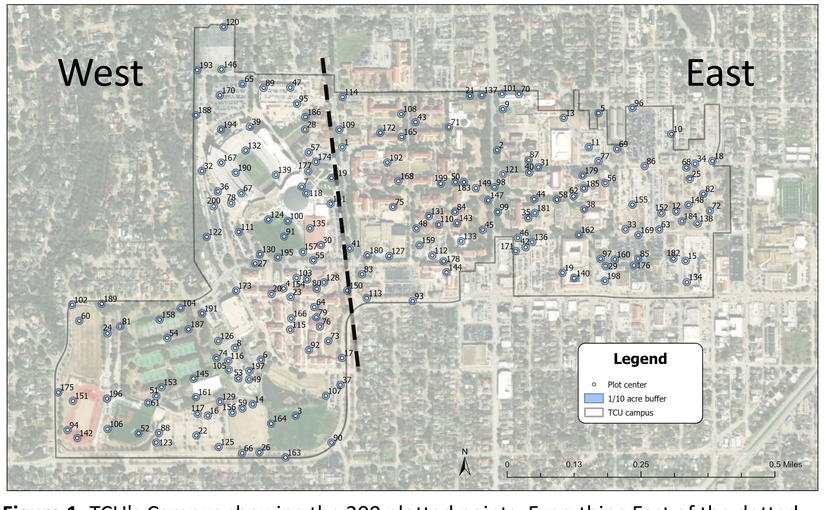


Figure 1. TCU's Campus showing the 200 plotted points. Everything East of the dotted line has been surveyed.

Discussion and Conclusions

Our research demonstrates the role of TCU's urban forest in carbon sequestration, air quality improvement, and stormwater management (Table 1). Our results show that there are approximately 2,914 trees on campus, serving as an important carbon sink, with an estimated carbon storage of about 2,791 tons (Figure 2a). TCU's urban forest also removes close to 2 tons of air pollutants and intercepts over 610,000 gallons of precipitation each year. TCU's urban forest is composed of a large proportion of live oak trees (37.7%) with a sprawling canopy (64.4%). These trees provide significant shade and cooling effects to the university community; however, if a pathogen, such as oak wilt, spread across campus, it would pose a serious threat to their health and longevity with significant replacement costs (Figure 2b). To combat this threat, TCU is working to diversify its urban forest through new tree plantings. Finally, our work highlights the importance of continued investment and stewardship to preserve campus trees for future Horned Frogs.

Acknowledgements

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