Assessing the Benefits of Urban Forestry in Mojave Desert Communities

Angela M. Hammond[1] and Nita Tallent-Halsell[2]

[1]USEPA, ORD, NERL, ESD, Student Services Contractor, Immediate Office, [2]USEPA, ORD, NERL, ESD, Landscape Ecology Branch

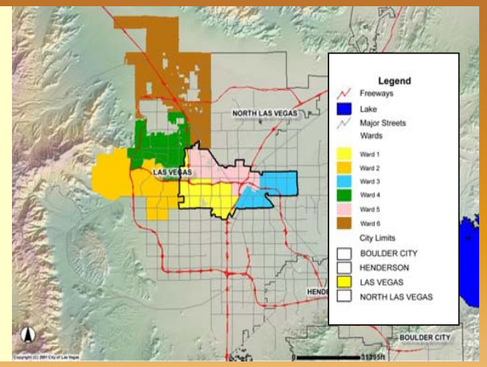
Objective:

As the climate and environment change due to human activity, an understanding of the existing natural resources becomes paramount. Urban forests of Mojave Desert communities have the potential to reduce air pollution, heat island effects, and energy consumption. Analyses of urban forestry benefits have been primarily conducted in temperate areas. The objective is to investigate the transferability of cost/benefit analysis to arid regions, utilizing the i-Tree model.

Study Area:

Clark County is located at the southernmost tip of Nevada and includes the cities of Las Vegas, North Las Vegas, and Henderson.

For this initial software trial, municipal tree inventory data, from three electoral districts of the city of Las Vegas were analyzed.



Methodology:

i-Tree is a free, peer-reviewed software suite developed by the USDA forest service. The i-Tree model can provide information on species distribution and the monetary benefits of an urban forest in the categories of energy, storm water, air quality, carbon dioxide, carbon stored, and aesthetic value; all important contributors to climate.

The module required STRATUM climate zones, tree species, and diameter breast height (DBH).

To demonstrate the functionality of i-Tree in desert landscapes, sample data was obtained from the City of Las Vegas Planning and Development department and analyzed using i-Tree Streets. The local population, land area, street and sidewalk width averages, municipal budget and planting cost data were estimated from census, map, and general budget information.

Results:

The most abundant species of the sample data set is the *Washingtonia robusta* (Mexican Fan Palm). In regards to air quality, it has a negative net benefit due to high biogenic volatile organic compound (BVOC) emissions. The recently added/planted species, *Fraxinus oxycarpa* (Caucasian Ash), has a relatively low net benefit. The longer established *Washingtonia filifera* (California Palm) has a moderate net benefit.

Results indicate that i-Tree analysis is applicable in arid regions if irrigation costs and benefit prices are accurately estimated. Species distribution also needs to be taken into account, as some trees are better suited for a desert environment than others.

The objective of the USEPA's Southwest Ecosystem Services Project (SwESP) is to develop and implement methods, models, and tools to map and assess the condition of Southwestern ecosystems. i-Tree is a valuable first step in understanding the value of Mojave Desert urban forests. Future studies will focus on the utilization of additional i-Tree modules to further understand the relationship between Southwest urban forestry, air quality, and climate.

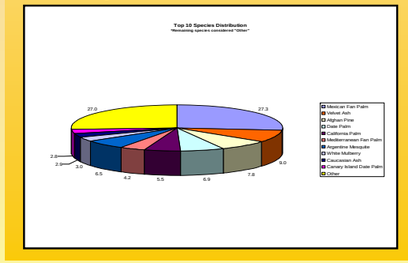
Annual Air Quality Benefits

Species	Deposition (lb) O_3	NO_2	PM_{10}	SO_2	Total Depos. ($)	Avoided (lb) NO_2	PM_{10}	VOC	SO_2	Total Avoided. ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	% of Total Trees	Avg. $/tree
Mexican fan palm	90.6	49.4	85.3	10.0	1,229	58.3	3.0	0.5	49.7	1,033	-617.3	-2,469	-270.4	-207	27.3	-0.10
Velvet ash	33.7	13.0	32.3	2.7	423	67.8	3.5	0.6	57.9	1,203	0.0	0	211.4	1,626	9.0	2.41
Afghan pine	118.7	64.7	115.6	13.1	1,632	103.0	5.3	0.9	88.2	1,832	-100.4	-402	409.1	3,063	7.8	5.23
Date palm	72.2	39.4	67.4	7.9	975	32.1	1.6	0.3	27.2	566	-444.8	-1,779	-196.7	-238	6.9	-0.46
California palm	7.3	4.0	6.8	0.8	99	80.6	4.1	0.7	68.7	1,428	-128.4	-514	44.6	1,013	5.5	2.46
Mediterranean fan palm	6.0	3.2	5.9	0.7	82	6.0	0.3	0.1	5.1	107	-63.3	-253	-36.0	-64	4.2	-0.20
Argentine mesquite	27.3	13.1	27.9	2.7	372	42.1	2.1	0.4	35.9	747	-40.6	-162	111.1	957	3.6	3.57
White mulberry	71.7	19.6	47.6	4.4	719	65.7	3.4	0.6	56.1	1,166	-109.6	-438	159.4	1,447	3.0	6.35
Caucasian ash	6.1	2.4	6.0	0.5	77	13.3	0.7	0.1	11.3	236	0.0	0	40.4	313	2.9	1.45
Canary Island date palm	133.1	72.6	124.4	14.6	1,799	69.3	3.5	0.6	59.2	1,230	-757.2	-3,029	-279.8	0	2.8	0.00
Siberian elm	213.8	82.7	164.0	17.1	2,439	112.1	5.7	1.0	96.2	1,997	0.0	0	692.7	4,436	2.2	26.72
Live oak	5.1	2.8	6.4	0.6	79	12.4	0.6	0.1	10.6	220	-170.0	-680	-131.3	-381	2.1	-2.44
Shoestring acacia	15.6	7.5	14.2	1.6	202	13.9	0.7	0.1	11.8	246	-33.2	-133	32.2	315	2.0	2.09
African sumac	2.5	1.3	3.2	0.3	39	6.8	0.3	0.1	5.8	120	0.0	0	20.3	159	1.8	1.16
Olive	12.2	6.6	12.5	1.3	171	13.9	0.7	0.1	11.9	247	-6.0	-24	53.4	395	1.7	3.06
Aleppo pine	38.0	20.7	39.0	4.2	534	41.4	2.1	0.4	35.5	738	-68.3	-273	113.0	999	1.5	9.17
Chinese pistache	4.6	1.8	4.4	0.4	57	9.2	0.5	0.1	7.9	164	-55.1	-220	-26.3	1	1.4	0.01
Locust	0.8	0.5	1.2	0.1	14	3.4	0.2	0.0	2.9	60	-10.4	-42	-1.4	32	1.3	0.34
Paloverde	9.8	4.7	10.1	1.0	133	15.1	0.8	0.1	12.9	267	-21.0	-84	33.4	317	1.2	3.41
Cherry plum	3.9	1.9	3.8	0.4	52	4.8	0.2	0.0	4.1	86	-10.7	-43	8.4	94	1.0	1.21
Other street trees	67.2	31.8	63.0	6.6	877	71.4	3.6	0.6	61.1	1,269	-211.7	-847	93.7	1,299	10.7	1.62
Citywide total	940.3	443.8	840.9	90.8	12,007	842.5	43.0	7.6	719.9	14,961	-2,847.9	-11,391	1,080.9	15,576	100.0	2.08

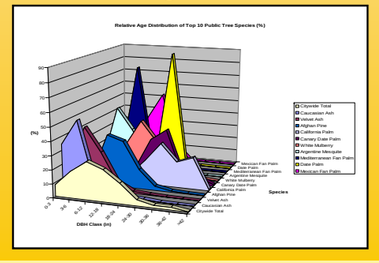
Total Annual Benefits

Benefits	Total ($)	$/tree	$/capita
Energy	56,725	7.57	0.20
CO_2	5,108	0.68	0.02
Air Quality	13,651	1.82	0.05
Stormwater	13,459	1.80	0.05
Aesthetic/Other	160,180	21.37	0.56
Total Benefits	249,123	33.24	0.88
Costs			
Planning	20,000	2.67	0.07
Contract Pruning	22,000	2.94	0.08
Pest Management	10,500	1.40	0.04
Irrigation	32,000	4.27	0.11
Removal	40,000	5.37	0.14
Administration	28,000	3.74	0.10
Inspection/Service	8,000	1.07	0.03
Infrastructure Repairs	13,000	1.73	0.05
Litter Clean-Up	26,000	3.47	0.09
Liability/Claims	10,000	1.33	0.04
Other Costs	1,000	0.13	0.00
Total Costs	210,500	28.09	0.74
Net Benetits	38,623	5.15	0.14
Benefit-cost ratio	1.18		

Species Distribution



Relative Age Distribution



Acknowledgements:

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