Ecosystem Services In Residential Land Management: Expressed Priorities, Distinctive Dimensions, & Regional Comparisons

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Introduction

Ecosystem services link the ecological structure & functioning of ecosystems to beneficial outcomes for people. These include provisioning, regulating, supporting, & cultural services. While research commonly uses economic valuation techniques to measure the market value of ecosystem services, little work has examined cultural services in detail & most research has focused on natural ecosystems (e.g. wetlands, forests) rather than human-dominated ones. We fill these gaps by examining how various landscape services are valued, wherein residential landscapes are positioned as the dominant human ecosystem in cities. In this poster, we specifically:

1. Evaluate expressed priorities for overall yard management & vegetation choices;
2. Compare regional differences across the 6 U.S. cities listed below; and
3. Explore the dimensions of ecosystem services relative to 4 types of ecosystem services as well as different types of landscape functions, both cultural & environmental.

Methods

For each of the objectives, we used the following methods of analysis.

1. Surveys in 6 different cities across the U.S. were conducted to assess priorities in ecosystem services—for both vegetation & overall yard choices, using a 4-point scale ranging from not important (0) to very important (4). The rating for various services is presented *below*.

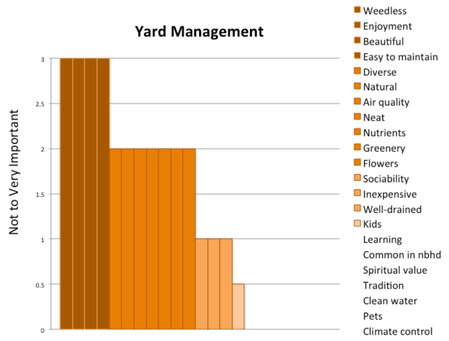
Regions	Ns
Phoenix (PHX)	30
Los Angeles (LAX)	10
Minneapolis (MSP)	21
Boston (BOS)	31
MIAMI (MIA)	23
Baltimore (BLT)	19
Total	**134**

2. Kruskal-Wallis & Analysis of Variance tests, as well as Tukey's post-hoc analyses, were conducted at the city level, pointing to regional differences on vegetation & yard management choices. The graphs at *upper right* depict statistically significant differences.

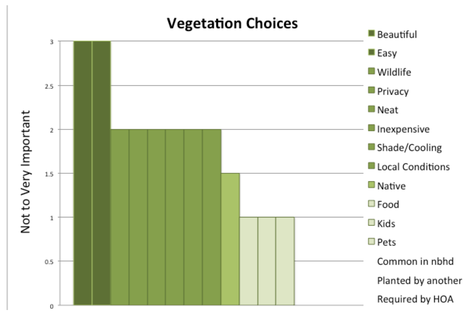
3. Factor analyses (with principal components extraction & promax rotation) were conducted to identify dimensions of ecosystem services & to create composite indices. Three variables (Kids, Pets, & Homeowners' Associations) were excluded since they are irrelevant to some households. After additional correlation (Spearman's rho) & reliability (Cronbach's alpha) tests, composite indices were created for specific sets of variables that reflect significant & reliable dimensions of ecosystem services (see *bottom center* & *upper right*).

1. Expressed Priorities for Vegetation & Yard Choices

In general, the most important priorities for yard management are beautiful & weed-free landscapes along with personal enjoyment & ease-of-maintenance.



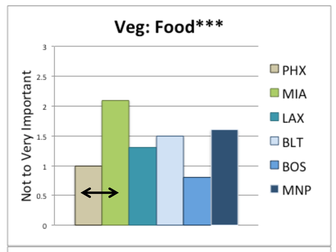
For vegetation choices, residents similarly prioritize beauty & ease-of-maintenance.

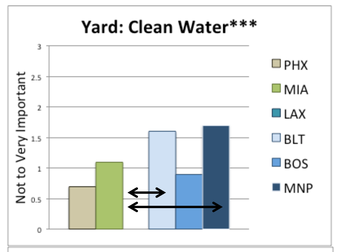


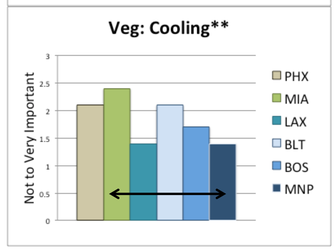
2. Regional Differences In Ecosystem Service Preferences for Landscaping Choices

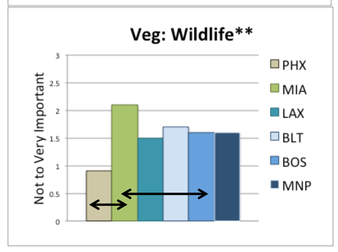
Overall, we did not find many regional differences for most ecosystem services. The exceptions are graphed *below*, with asterisks indicating the omnibus test of statistically significant differences at **p < 0.01*** & p < 0.05**** (for Kruskal-Wallis tests). The pair-wise comparisons are also shown with the arrows based on Tukey's post-hoc tests.

Regional differences were mostly for vegetation choices, particularly provisioning services such as food & wildlife, & the regulating services of cooling & shading the local environment. In particular, Miami stood out among the 6 cities as most distinctive in that residents there placed higher value on these services, though relative to different cities for different ecosystem values. For yard choices overall, the only regional difference was for the supporting service of pollution reduction, which was more highly valued in Minneapolis & Baltimore compared to Los Angeles. These preliminary findings must be explored further however, given the small sample sizes for the 6 cities (see next steps, *below right*).









3. Factor Analysis Results: Dimensions of Ecosystem Service Preferences

YARD CHOICES OVERALL

Individual Variables	Local Values	Environmental Maintenance	Floral Biodiversity	Neat Aesthetics	Inexpensive
Spiritual Values [1]	**.793**				
Learning [1]	**.764**				
Reflects Tradition [1]	**.705**				
Socializing	.599				
Climate	.463				
Air Quality	.389				
Easy to Maintain [8]		**.816**			
Water Quality [2]		.586			
Well-drained [2]		.571			
Weedless		.521			
Soil Nutrients [2]		.486			
Flowers [3]			**.936**		
Plant Diversity [3]			**.842**		
Greenery			.483		
Beauty [5]				**.892**	
Enjoyment				.549	
Neatness [4]				.540	
Inexpensive [6]					**.825**
Common					.570
Eigenvalues	5.88	2.14	1.59	1.20	1.01
% Variance	29.4	10.7	7.9	6.0	5.1
& Cumulative Var.	29.4	40.1	48.1	54.0	59.1
Cronbach's Alpha	*0.814*	*0.699*	*0.666*	*0.566*	*rho = 0.38*

The **bolded** items in these tables indicate factors that loaded highly on distinctive dimensions of ecosystem services, & thus were included as composite variables (at *right*).

For yard choices in general, cultural values & a mix of environmental maintenance priorities comprised the 1st & 2nd factors, respectively. These factors were highly reliable (i.e., internally consistent) based on the Cronbach's alpha criterion of >0.7. A 3rd factor emerged as the provisioning of floral diversity, while the 4th & 5th were dominated by single variables (beauty & costs). The 3rd-5th factors are acceptable for early research at alpha >0.5.

Factors of vegetation choices (*right*) highlighted cultural & provisioning services. The 1st factor was dominated by native plants & wildlife provisioning. The 2nd & 3rd cultural dimensions featured local traditions & neatness. Similar to yard choices (table *above*), the 4th (low costs) & 5th (low maintenance) factors comprised single items.

From these results, we refined these factors of ecosystem services to produce the statistically reliable composite scales for further analysis (see *upper right*).

VEGETATION CHOICES

Individual Variables	Native Environment	Local Legacies	Neat Aesthetics	Inexpensive	Ease
Native Plants [7]	**.812**				
Wildlife [7]	**.768**				
Food	.659				
Cooling	.479				
Planted by Another		**.762**			
Local Conditions		.644			
Common in Nbhd.		.547			
Beautiful [5]			**.775**		
Neatness [4]			**.756**		
Privacy			.470		
Inexpensive [6]				**.906**	
Easy to Maintain [8]					**.942**
Eigenvalue	2.79	1.55	1.34	1.05	1.03
% Variance	23.3	12.9	11.2	8.7	8.7
% Cumulative Var.	23.3	36.2	47.3	56.1	64.7
Cronbach's Alpha	*0.66*	*0.57*	*0.46*	*n.a.*	*n.a.*

3. Composite Scales for Ecosystem Service

Below are the aggregate scales (created by averaging 2 or more individual items) that we developed based on the factor & reliability analyses, along with bivariate correlations for scales with only 2 variables (for 3 or more, Cronbach's alpha was used to test for reliability). These scales will be used for further analysis of regional differences & other patterns in ecosystem services (e.g., see poster by Larson et al.).

In sum, these dimensions capture various provisioning, regulating, supporting, & cultural types of services for yard & vegetation choices. In some cases, variables were combined across yard & vegetation choices, specifically to represent Neatness, Appearances, Low Maintenance, & Low Costs as distinctive dimensions of ecosystem services, or in other words, human values of ecosystems.

alpha = Cronbach's test
>0.7 signifies reliability; >0.5 is adequate for early research

rho = Spearman's correlations
all pair-wise correlations significant at p<0.01 level***

[3] *Floral Biodiversity* → *rho* = **0.529**
[Yard] provides flowers
[Yard] offers a variety of plants

[7] *Local Nature Provisioning* → *rho* = **0.488**
[Vegetation] is native to the area
[Vegetation] supports wildlife

[2] *Supporting Environmental Services* → *alpha* = **0.754**
[Yard] reduces pollution in local water bodies
[Yard] reduces flooding or standing water
[Yard] provides nutrients to improve soils

[1] *Local Cultural Values* → *alpha* = **0.745**
[Yard] reflects my religious/spiritual values
[Yard] reflects my tradition & heritage
[Yard] provides opportunities to explore & learn about nature & the environment

[4] *Neat Aesthetic* → *rho* =**0.684**
[Yard] is neat & orderly
[Vegetation] is neat & orderly

[5] *Appearances* → *rho* =**0.649**
Creates a beautiful [yard]
[Vegetation] creates a beautiful [yard]

[8] *Low Maintenance* → *rho* =**0.480**
[Yard] is easy to maintain
[Vegetation] is easy to maintain

[6] *Low Costs* → *rho* =**0.763**
[Yard] is inexpensive
[Vegetation] is Inexpensive

Other individual variables from the survey:

- *Provisioning*: provides food;
- *Regulating*: provides shade or helps cool the climate; helps with climate change;
- *Supporting*: improves the air we breathe; is suited to my yard conditions;
- *Cultural*: several individual variables include the following
  - *Aesthetic Qualities*: reduces weeds; makes things green; looks natural
  - *Personal Purposes*: provides personal enjoyment; supports socializing; [vegetation] provides privacy or seclusion;
  - *Social Legacies* : [vegetation] is common in my neighborhood; [vegetation] was planted by previous owner.

Conclusions & Next Steps

Within residential landscapes, priorities are mostly found in aesthetic values & ease of maintenance across the U.S. Provisioning ecosystem services, particularly biodiversity & wildlife, were also highly valued in this cross-regional study. Regarding differences among cities, we see significant homogeneity in preferences since only a few of the several variables analyzed differed across 6 cities. With respect to heterogeneity, Miami especially stands out as unique. Future research will explore why this region is so distinctive in their values. Meanwhile, some regional differences are rather obvious , such as cooling being more important in hot Miami compared to cold Minneapolis. Lastly, the factor analysis revealed important dimensions of ecosystem services, generally following along the classic division of provisioning, regulating, supporting, & cultural services. As we move forward, additional analyses will employ the composite variables while examining broader regional differences across the eastern vs. western cities as well as those in the north vs. the south.

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