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Research

Resident perceptions of natural resources between cities and across scales in the Pacific Northwest

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ABSTRACT. As the global population becomes increasingly urban, research is needed to explore how local culture, land use, and policy will influence urban natural resource management. We used a broad-scale comparative approach and survey of residents within the Portland (Oregon)-Vancouver (Washington) metropolitan areas, USA, two states with similar geographical and ecological characteristics, but different approaches to land-use planning, to explore resident perceptions about natural resources at three scales of analysis: property level ("at or near my house"), neighborhood ("within a 20-minute walk from my house"), and metro level ("across the metro area"). At the metro-level scale, nonmetric multidimensional scaling revealed that the two cities were quite similar. However, affinity for particular landscape characteristics existed within each city with the greatest difference generally at the property-level scale. Portland respondents expressed affinity for large mature trees, tree-lined streets, public transportation, and proximity to stores and services. Vancouver respondents expressed affinity for plentiful accessible parking. We suggest three explanations that likely are not mutually exclusive. First, respondents are segmented based on preferences for particular amenities, such as convenience versus commuter needs. Second, historical land-use and tax policy legacies may influence individual decisions. Third, more environmentally attuned worldviews may influence an individual's desire to produce environmentally friendly outcomes. Our findings highlight the importance of acknowledging variations in residents' affinities for landscape characteristics across different scales and locations because these differences may influence future land-use policies about urban natural resources.

Key Words: *human dimensions; landscape ecology; natural resources; Pacific Northwest; perceptions; urban ecosystems*

INTRODUCTION

More than 80% of Americans and more than 65% of the global human population are expected to live in urban areas by 2050 (USDC 2014, United Nations 2014). Accommodating for this influx, the amount of "urban" land cover is projected to triple by 2030 (Seto et al. 2011, 2012). Based on past trends (McDonnell and Pickett 1997, Collins et al. 2000, Alberti et al. 2003, Duh et al. 2008), the interplay of socioeconomic and ecological factors will influence development outcomes and what urban landscapes look like over time. Strategies exist to balance ecological sustainability and urban human infrastructure (Ahern 2013), and research is exploring such linkages (e.g., Morzillo and Schwartz 2011, Londoño Cadavid 2013, Chang et al. 2014, Everett et al. 2016). Less is known, however, about the integrated role of human governance and land-use planning strategies and resulting impacts on the social and ecological resilience of urban landscapes.

Cities evolve as a result of independent yet interacting choices by humans at multiple scales within a biophysical framework (Collins et al. 2011), producing different landscape patterns with unique biophysical properties (e.g., Pickett and McDonnell 1993, Pickett et al. 2001, Grimm et al. 2008). This complexity results from polycentric decision making among varying scales of governance (Ostrom 2010), ranging from broad institutional down to the individual resident, that correspond to changes of both ecosystem function and social perception of those functions (Elmqvist et al. 2013). However, open questions remain about how such interscalar social-ecological relationships interact to express environmental outcomes and decisions influencing environmental attributes and ecosystem services.

An essential aspect of urban social-ecological interactions is the individual resident: his/her perceptions of the urban environment around him/her, and how he/she is empowered by local governance structures. At the most basic level, resident population is the metric used to define city size (USDC 2014). Behaviors by this key subset of urban stakeholders at the property level translate into patterns across neighborhoods and urban landscapes (Kinzig et al. 2005, Cook et al. 2012, Belaire et al. 2014). Revealed and stated preference models (Champ et al. 2003, Freeman 2003) have suggested the influence of environmental characteristics, such as water quality (Netusil et al. 2014), open space proximity (Geoghegan 2002), trees (Donovan and Butry 2010), and green stormwater management (Ando and Freitas 2011), on property values. Relationships exist between socioeconomic profiles and personal preferences for urban characteristics (e.g., Muller 1982), which play a central role in determining where an individual chooses to live (Tiebout 1956). For example, although preference for an oasis front yard motif was expressed among all residents, "inmigrants" to Phoenix from the U.S. Southeast, Great Plains, and Intermountain West were more likely to choose neighborhoods with neighborhood community associations than inmigrants from the Northeast, Midwest, Southwest, and Pacific West (Martin et al. 2003). In this case, property-scale landscape preferences were not always

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Table 1. Hypotheses used to evaluate differences between Portland and Vancouver across three scales, and results of analysis.

Hypothesis	Supported?
H1: A greater number of Portland respondents would indicate importance for natural resources characteristics than Vancouver respondents.	No
H2: In each city, the percent of respondents who indicated the importance of each landscape characteristic would vary across scales.	Yes
H3: Convenience-related features, such as stores and services and urban parks, are more likely to be ranked as important at the property-level and neighborhood scale for Portland than Vancouver.	Yes
H4: Accessible parking is more likely to be important for Vancouver residents across scales.	Yes
H5: Portland respondents are more likely to have greater new ecological paradigm (NEP) scores than Vancouver respondents.	Yes
H6: Vancouver respondents exhibit more anthropocentric and use-based value orientations than Portland respondents.	Generally

consistent with neighborhood-scale governance preferences. Thus, we postulate that individual preferences vary across scales, influencing what urban landscapes look like over time.

We explored this supposition using a suite of urban natural resource and social landscape characteristics that may be important to residents. Portland (Oregon) and Vancouver (Washington) were explicitly chosen for comparison because the two cities have similar biophysical attributes, but over time have taken distinctly different forms of social and political governance. This metropolitan area consists of two million people and spans the boundary of two states divided by the Columbia River. Within a 50-mile radius are three national forests, two state forests, and many mountain, river, and beach recreation opportunities. Set between the Cascade and Coast mountain ranges, the region experiences a mild marine-influenced climate with summer drought and winter rains. The two cities are tightly linked by watersheds, airsheds, and commuter sheds. Interstate 5 connects and bisects both cities, along with major north-south and east-west railroads. Estimates suggest that the area will grow by approximately 1.5 million inhabitants by 2030 (USDC 2014). More broadly, this effort is one component of the Portland-Vancouver Urban Long-Term Research Area Exploratory (ULTRA-Ex) project, the objective of which is to understand how human and biophysical systems respond over time to disturbances in urban social-ecological systems.

Despite the similar geographies of Portland and Vancouver (two largest cities on the Oregon and Washington sides of the metropolitan area; populations approximately 600,000 and 165,000, respectively; USDC 2014), land-use planning histories have shaped regional urban development in Oregon and Washington (Kline et al. 2014). The Oregon Land Conservation and Development Act of 1973 included 19 goals to safeguard opportunity for natural resources extraction and to protect the economic value of agricultural production. Goal 14, "urbanization," describes the establishment of and conditions for making changes to urban growth boundaries (UGBs) for each city in the state and requires state-approved comprehensive planning at the local level (Oregon Department of Land Conservation and Development 2006). In 1991, Washington passed the Growth Management Act that established UGBs to manage growth and protect open space in response to rapid development surrounding Puget Sound (Kline et al. 2014). Comparatively, Washington's guidelines are less centralized with greater local-level management than Oregon's. Although UGBs have contained development in both states (Kline et al. 2014, Lettman et al. 2014), it is unknown what role, if any, these differences, and factors such as tax policies, land-use planning decisions, natural resource preferences, and access to mass transit, have had on trends in social perspectives between Portland and Vancouver, including residential perspectives of urban natural resources.

Besides diverse state land-use histories, a general reputation for sustainability and greenness has been ascribed to Portland (Greenbiz 2008, Svoboda et al. 2008) when compared to neighboring Vancouver. Our working hypothesis is that the varying history of land-use governance and reputation for greenness are reflected in resident perceptions such that a greater number of Portland respondents would indicate importance for natural resource characteristics than Vancouver respondents (Table 1, H1). Support for this hypothesis in our study may illustrate ways in which institutional differences and land-use governance interact and are emulated by residential perceptions and behaviors. To test this hypothesis, we assessed the importance of 15 selected landscape characteristics for each city at three scales of analysis. Then, we applied both univariate and multivariate techniques to compare and contrast similarities and differences between the two cities. Finally, we considered three factors that may be attributed to differences in responses from each city and contribute to residential perspectives of the cities over time.

METHODS

Data collection

Our study extent included similar neighborhoods, both relatively close to and far from urban natural resources, such as streams and other green infrastructure. A mail survey was used for data collection. Our sampling unit was the individual household, and we defined our sampling frame as the list of residential street addresses within the study extent. Street address information was purchased from Marketing Systems Group (Fort Washington, PA), which compiles sampling datasets from U.S. Postal Service delivery sequence files. Single delivery points for multiple addresses, e.g., post office boxes and mail drops, were excluded to preserve spatial context. We also excluded apartment buildings to maximize representation of individuals who make decisions at the scale of individual residential lots.

We used multiple mailings in an effort to increase response rates (Dillman et al. 2009) and based the sample size on a desired sampling error of ± 5%. In 2012, we sent questionnaires to randomly selected households in Portland and Vancouver (n =

Table 2. Derivation of environmental worldview variables (adapted from Dunlap et al. 2000).

Statement	Variable				
	DSP[†]	NEP[‡]	Catastrophe	Nonintervene	Ingenuity
We are approaching the limit of the number of people the Earth can support		X	X		
Humans have the right to modify the natural environment to suit their needs	X			X	
When humans interfere with nature it often produces disastrous consequences		X		X	
Human ingenuity will insure that we do NOT make the Earth unlivable	X				X
Humans are severely abusing the environment		X	X		
The Earth has plenty of natural resources if we just learn how to develop them	X				X
Plants and animals have as much right as humans to exist		X		X	
The balance of nature is strong enough to cope with the impact of modern industrial nations	X				X
Despite our special abilities, humans are still subject to the laws of nature		X		X	
The so-called ecological crisis facing mankind has been greatly exaggerated	X				
The Earth is like a spaceship with very limited room and resources		X	X		
Humans were meant to rule over the rest of nature	X			X	
The balance of nature is very delicate and easily upset		X	X		
Humans will eventually learn enough about how nature works to be able to control it	X				X
If things continue on their present course, we will soon experience a major ecological catastrophe		X	X		

[†] DSP = dominant social paradigm; [‡] NEP = new ecological paradigm. Cronbach's alpha (α) provided a measure of internal reliability for each group of statements: DSP α = 0.771, NEP α = 0.828; catastrophe α = 0.795; nonintervene α = 0.712; and ingenuity α = 0.666.

3000 each; N = 6000). A follow-up telephone survey (n = 132) of nonrespondents to the original survey revealed that the most common reason for nonresponse was not receiving the original survey (n = 64; 48%).

Landscape characteristics and scales of perception (dependent variables)

To evaluate the importance of landscape characteristics, respondents were asked to respond to 15 items as either "important" (1) or "not important" (0). These items included: (a) large mature trees; (b) tree-lined streets; (c) native vegetation; (d) vegetation that is attractive all year; (e) landscaping with low-cost maintenance; (f) reliably colorful flowers; (g) well-manicured vegetation; (h) streams or rivers; (i) vegetation along streams; (j) urban (landscaped) parks; (k) parks with trails and natural areas; (l) plentiful accessible parking; (m) natural stormwater management; (n) public transportation; and (o) stores and services. Responses to each item were indicated at three spatial scales. Consequently, we hypothesized that in each city, the percent of respondents who indicated the importance of each landscape characteristic would vary across scales (Table 1, H2).

First, the finest scale of analysis was the individual property-level scale, "at or next to my house." Individual households are the fundamental unit of urban land management (Chowdhury et al. 2011) and the center of residential decision making (Shakeel and Conway 2014). Past research suggests that property-level decisions, such as landscaping preferences (e.g., Yabiku et al. 2008), may be associated with socioeconomics (e.g., Troy et al. 2007), property values (Kadish and Netusil 2012), vegetation preferences (e.g., Schroeder et al. 2006, Dahmus and Nelson 2014), and value orientations (Kaltenborn and Bjerke 2002).

Then, we selected two additional scales for comparison: a neighborhood scale, "within a 20-minute walk from my house" and a metro-area scale, "across the metro area." Even in the most crowded cities, appreciation exists for features such as urban parks and greenspaces (Gidlöf-Gunnarsson and Öhrström 2007, Hoffman et al. 2012, Lo and Jim 2012), bike trails (Krizek and Johnson 2006), dispersed development (Filion et al. 1999), and walkability (Leyden 2003), which allows for maintenance of ecosystem goods and services alongside planning goals (e.g., Tratalos et al. 2007). A goal of the City of Portland and the *Multnomah County Climate Action Plan* (City of Portland 2009) is to establish commercial services and amenities within a 20-minute walk of all residences. This distance has been used to assess relationships between property values and green infrastructure (Mahan et al. 2000, Netusil et al. 2010). We hypothesize that convenience-related features, such as stores and services and urban parks, will more likely be important at the property- and neighborhood-level scales for Portland than for Vancouver given Portland's policies to promote walkable neighborhoods (Table 1, H3), whereas accessible parking is more likely to be important for Vancouver (Table 1, H4).

Independent variables

Environmental worldview

Values are guiding ethical and moral principles for decision making and are influenced by cultural and environmental constructs (Dietz et al. 2005). We used the new ecological paradigm (NEP) framework, a common metric for assessing human understandings of and relationship with nature, to measure environmental worldviews (values) of our respondents (Table 2; Dunlap et al. 2000). Following the logic and directionality of H1, we expected that Portland respondents would be more likely to have greater NEP scores than Vancouver respondents (Table 1, H5). We used exploratory factor analysis, i.e., principle components analysis (PCA), (Sokal and Rohlf 1995, Morzillo and Mertig 2011*a*) for data reduction to combine

Table 3. Derivation of value orientations variables.

Variable[†]	Survey items applied to variable creation
HumDom	(a) Humans should manage nature so that only humans benefit
	(b) The needs of humans are more important than the needs of nature
	(c) The primary value of nature is to provide benefits for humans
	(d) Nature exists primarily to be viewed by humans
Protectionist	(a) The rights of nature are more important than human uses of nature
	(b) Nature should be protected for its own sake rather than to simply meet the needs of humans
	(c) I care about nature as much as I care about people
	(d) Nature is like family so it should be protected
	(e) We should focus on doing what is best for nature instead of what is best for best for humans
	(f) People should not treat nature in ways that cause destruction to nature, no matter how much humans benefit
Nature	(a) Having nature near my home is important to me
	(b) I enjoy seeing nature around my house
	(c) I notice the nature around me every day
	(d) Nature is an important part of my neighborhood
	(e) It is important to take care of nature for future generations
	(f) It is important to know that nature exists
	(g) It is important to know that nature is in good condition
	(h) I enjoy learning about nature
	(i) It is important that we learn as much as we can about nature
	(j) It is important that all residents can learn about nature

[†] HumDom = human-dominated value orientation; protectionist = protectionist value orientation; nature = individual relationship with nature. Cronbach's alpha (α) provided a measure of internal reliability for each group of statements: HumDom; α = 0.813; protectionist; α = 0.800; nature; α = 0.930.

statements that factored together and to construct scale scores. Cronbach's alpha (α; Cortina 1993) provided a measure of internal reliability for each group of statements. Factor analysis produced five variables. Two variables were based on the traditional NEP (dominant social paradigm or DSP, NEP; Dunlap et al. 2000), and three were based on revealed themes of potential for environmental catastrophe (Catastrophe; Table 2), environmental dominance over human intervention (Nonintervene), and prevalence of human ingenuity over environment (Ingenuity).

Value orientations

Similar to values, value orientations are revealed through decision making related to codes of conduct and relationships between individuals and other people or objects (Forsyth 2006). Whereas values are based on moral principles, value orientations focus on concerns about object importance and risk (Schultz 2001, Dietz et al. 2005). Value orientations range along continua often described as biocentric-anthropocentric and protection-use (Fulton et al. 1996, Vaske et al. 2001), in which individual preferences may be reflected by perceptions (Larsen and Harland 2006) and influenced by socioeconomics (e.g., Dutcher et al. 2007). In the human dimensions of natural resources discipline, assessment of value orientations has informed the management of wildlife (e.g., Bright et al. 2000), forests (Steel et al. 1994), and landscape characteristics (Kaltenborn and Bjerke 2002). Consistent with H1 and H5, we expected that Portland respondents would exhibit fewer anthropocentric and use-based orientations than Vancouver respondents (Table 1, H6).

We assessed value orientations using three variables adapted from past research (Steel et al. 1994, Fulton et al. 1996, Bright et al. 2000, Vaske et al. 2001, Needham 2010). Two variables included subsets of 15 statements focused on general human relationships with natural resources. Using Likert format, responses to each statement were coded to indicate the level of agreement (5 = strongly agree; 4 = agree; 3 = unsure; 2 = disagree; 1 = strongly disagree); PCA and Cronbach's alpha were applied to create scale scores. Four items factored together suggesting a human-dominated value orientation (Table 3, HumDom). Six items factored together suggesting a protectionist value orientation (Protectionist). The third variable was focused specifically on individual relationships with nature. Respondents indicated the extent that they agreed with 10 statements (Table 3, Nature), which were added together to create a scale score.

Socioeconomics

Relationships exist among socioeconomic characteristics, environmental values and orientations, and attitudes toward and behaviors related to natural resource management (e.g., Koval and Mertig 2004, Morzillo et al. 2007, Sidique et al. 2010, Morzillo and Mertig 2011*a*, Carter et al. 2014). Therefore, we included seven socioeconomic variables to describe respondents from our sample from both cities (Table 4).

Statistical analysis

We applied both univariate and multivariate approaches to data analysis. Univariate approaches allowed us to explore sequential differences between landscape characteristics for each city and at each scale. Multivariate techniques allowed us to explore differences between cities and scales while taking into account the entirety of survey responses. Consequently, the univariate approaches can be viewed as direct and focused questioning of differences at the individual trait level (individual landscape characteristics), and the multivariate approaches can be viewed as inquiring into the differences while considering a global view of the data. It was not our goal to present two divergent

Table 4. Demographic or socioeconomic variables and sample characteristics of respondents.

Demographic or socioeconomic measure[†‡]	Portland		Vancouver	
	n		n	
Children (% households with children)	627	32	439	27
Tenure (mean months in current residence ± SD)	637	162 (± 157)	451	163 (± 157)
Own (% respondents own their residence)	646	82	452	85
Sex (% respondents who are female)	645	58	451	59
Age (mean age in years ± SD)*	625	51 (± 15)	436	55 (± 16)
Education (% of respondents at each level)*	645		455	
Less than high school		1		1
High school graduate or equivalent (e.g., GED)		5		8
Vocational or trade school		3		4
Some college		11		21
College degree (2-year or certificate)		6		13
College degree (Bachelor's)		35		32
Graduate or professional degree		40		21
Income (% of respondents in each income bracket)*	610		420	
Less than $25,000		12		11
$25,000 to $49,999		19		27
$50,000 to $74,999		23		28
$75,000 to $99,999		17		15
$100,000 or more		30		19

[†] An asterisk (*) denotes a significant difference between locations at the 95% confidence level for age ($r = 0.116$, $p < 0.000$), education ($F = 11.156$, $df = 6, 1093$, $p < 0.000$), and income ($F = 5.665$, $df = 4, 1025$, $p < 0.000$).
[‡] Rounding may result in numbers not adding to 100%.

perspectives of the data, but rather to illustrate a comprehensive and holistic examination of the survey results that merge into one integrated summary of the data. All alpha values were defined as significant at the 95% confidence interval ($\alpha = 0.05$).

Chi-square, ANOVA, and Pearson's *r* (Sokal and Rohlf 1995) were used to compare sample means and to test bivariate relationships of socioeconomic, environmental worldview, and value orientation variables between Portland and Vancouver. Effect size (Gliner et al. 2001) was used to assess the strength of the relationships between variables, as appropriate. All univariate statistics were conducted in SPSS, unless otherwise noted.

We evaluated the importance of landscape characteristics across scales and between cities in two ways. First, nonmetric multidimensional scaling (NMDS) was used to reduce the dimensionality of all data and to explore main data patterns between the two cities. Nonmetric multidimensional scaling is a nonparametric ordination technique that measures agreement between the distance in ordination space and observed dissimilarity between survey responses (Kruskal 1964, Kruskal and Wish 1978). The agreement between ordination space and observed dissimilarity is measured by calculating stress, which is reported as a goodness of fit measure for the final NMDS. Survey responses to landscape characteristics were treated as categorical with equal distance between responses, and a Gower's measure of distance was used to calculate distance in dissimilarity (Clarke 1993). Nonmetric multidimensional scaling and indicator analyses (Dixon 2003) were completed in R-3.0.2 using the "vegan" and "daisy" packages (R Core Team 2015).

Second, we used frequency analysis to identify the relative importance of each landscape characteristic at each scale for each city, and Chi-square analysis to test for differences between cities. Then, we applied indicator analysis (Dufrene and Legendre 1997) to calculate an overall measure of "fidelity" (affinity) for each landscape characteristic for each city; significance was tested by comparing a standard deviation weighted mean indicator value (from 1000 permutations) to the observed indicator value. Indicator species analysis was conducted in R-3.0.2 using the "labdsv" package.

RESULTS

Sample characteristics

The overall response rate was 18% (Portland $n = 664$; Vancouver $n = 464$). A majority of respondents were female (59%) and average (± SD) age was 53 ± 15 years. In general, Portland respondents were more likely to have children in their household, shorter residential tenure, rent, younger ages, more formal education completed, and greater incomes than Vancouver respondents (Table 4). Compared to the overall population of both cities, respondents were older, had more formal education completed, and greater household incomes (USDC 2014).

Data patterns for landscape characteristics of the two cities

The final three-dimensional NMDS had a stress value of 0.16, which is considered to be an acceptable representation of the data (Clarke 1993). In the reduced dimensionality of our final NMDS space, there is complete mixing of Portland and Vancouver responses. Essentially, there is no shared collective pattern of important and not-important responses by residents of either city at any scale. Although the divergence between Portland and Vancouver was greatest at the metro level, relative differences in the individual questions did not result in separate clusters for each city (i.e., heterogeneity was washed out when collectively considering all positive and negative responses). Therefore, for the global multidimensional view of the data, the NMDS illustrates that the cities are indistinguishable from each other, contrasting with our hypothesis (Table 1, H1).

Table 5. Indicator analysis illustrating trends in divergence† between cities and across three scales for landscape characteristics.

	Property level		Neighborhood level		Metro-area level	
Dependent Variable	Portland	Vancouver	Portland	Vancouver	Portland	Vancouver
Large mature trees	**0.426**	0.352	**0.500**	0.425	**0.496**	0.446
Tree-lined streets	**0.451**	0.301	**0.486**	0.343	**0.477**	0.376
Native vegetation	0.417	0.382	0.457	0.438	0.477	0.440
Vegetation that is attractive all year	0.334	**0.398**	0.343	0.382	0.355	0.380
Landscaping with low-cost maintenance	0.436	0.459	0.357	**0.458**	0.389	**0.451**
Reliably colorful flowers	0.269	0.300	0.271	0.282	0.295	0.259
Well-manicured vegetation	0.251	**0.356**	0.267	0.319	0.271	0.296
Streams or rivers	0.157	**0.235**	0.341	0.379	0.481	0.448
Vegetation along streams	0.276	0.338	0.393	**0.454**	**0.495**	0.442
Urban (landscaped) parks	0.326	0.279	**0.474**	0.423	0.484	0.450
Parks with trails and natural areas	0.288	0.311	0.462	0.445	0.497	0.479
Plentiful accessible parking	0.204	**0.276**	0.189	**0.381**	0.303	**0.450**
Natural stormwater management	0.425	0.431	0.456	0.471	0.481	0.470
Public transportation	**0.492**	0.164	**0.501**	0.346	**0.500**	0.413
Stores and services	**0.336**	0.149	**0.501**	0.375	**0.495**	0.438

† Bold font indicates (1) variables for which significant difference between cities at the 95% confidence interval for each scale of analysis and (2) the city for which there was greater "fidelity" (affinity) to that variable. At the 90% confidence level, affinity also existed at the property level in Vancouver for vegetation along streams (0.338), and at the metro level in Portland for native vegetation (0.477) and urban (landscaped) parks (0.484).

However, inter- and intra-city divergences were revealed for absolute differences in individual responses to discrete landscape characteristics, which varied statistically across scales for 12 of 15 landscape characteristics (Table 1, H2; Fig. 1). At the property-level scale, stores and services were considered important by the fewest Vancouver respondents, whereas streams and rivers were important to the fewest Portland respondents. At the neighborhood scale, general patterns supported our hypothesis (Table 1, H3). Large mature trees and natural stormwater management were important to the most Portland and Vancouver respondents, respectively. Conversely, plentiful accessible parking and reliable colorful flowers were least important to the Portland and Vancouver respondents, respectively. General patterns also supported our hypothesis (H3) at the metro scale, with parks with trails and natural areas identified as important to respondents in both cities.

Indicator analysis illustrated that Portland respondents showed stronger fidelity (affinity) for large mature trees, tree-lined streets, public transportation, and stores and services across all scales (Table 5). Vancouver respondents exhibited stronger affinity for plentiful accessible parking across all scales (Table 1, H4). At the property-level scale, Vancouver respondents also showed stronger affinity for vegetation that is attractive all year, well-manicured vegetation, and streams or rivers. At the neighborhood scale, Portland respondents also showed stronger affinity for urban (landscaped) parks, whereas Vancouver respondents exhibited stronger affinity for landscaping with low-cost maintenance and vegetation along streams. At the metro-area scale, Portland and Vancouver respondents also showed stronger affinity for vegetation along streams and landscaping with low-cost maintenance, respectively. The greater affinity for vegetation along streams at the neighborhood scale in Vancouver flips to Portland at the metro scale. Collectively, the magnitude of difference of affinity was generally greatest at the property-level scale.

Environmental variables

Results of the environmental worldview analysis supported our hypothesis (Table 1, H5) that Vancouver respondents were more likely to report greater scale scores for DSP; Portland scores were more likely to be greater for NEP (Table 6). Combined scores for both cities were at the relatively low and high ends of the range for DSP and NEP, respectively. Portland respondents were more likely to report greater scale scores for Catastrophe and Nonintervene; Vancouver respondents were more likely to report greater scale scores for Ingenuity. For value orientations, HumDom values were more likely greater for Vancouver than Portland, which supports our hypothesis (H6), but Protectionist did not vary between the two cities (Table 6). Portland respondents were more likely to indicate a greater personal importance of Nature.

DISCUSSION

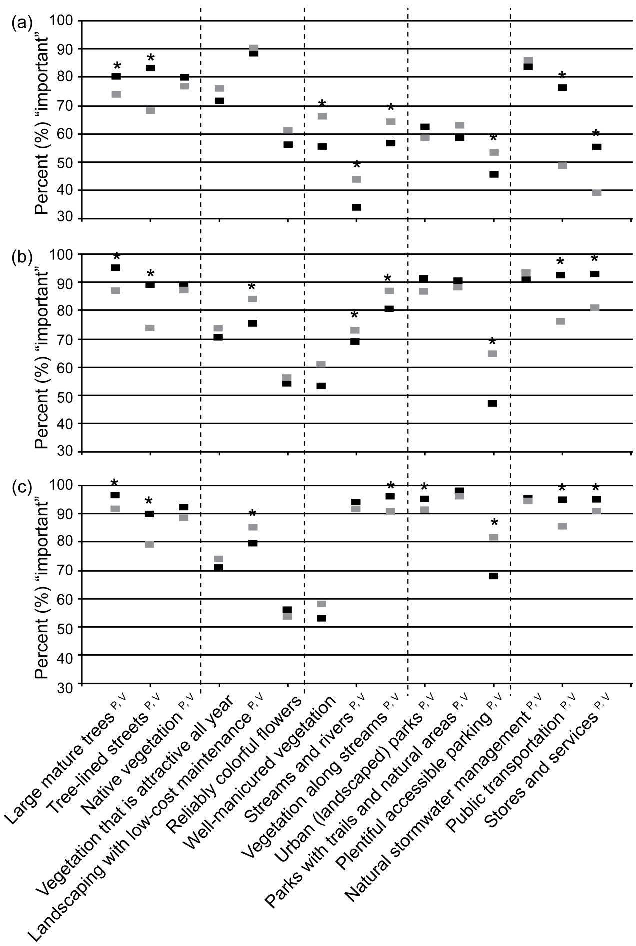
Decisions by urban residents have regional- and global-level impacts on ecological patterns and processes (Shochat et al. 2006, Pickett et al. 2008, Yeakley et al. 2014), including net primary productivity (Milesi et al. 2003), nutrient composition (Zhu et al. 2004), invasive species (Berland and Elliott 2014), and biodiversity (Kinzig et al. 2005, Goddard et al. 2010). These collective decisions contribute to feedbacks among other urban governance structures (Liu et al. 2007, Cook et al. 2012, Morzillo et al. 2014, Polsky et al. 2014) that influence what urban landscapes look like over time. Our hypothesis that Portland respondents would reveal more overall importance for natural resources than Vancouver respondents did not bear out at the metro scale. Rather, the two cities were quite similar. However, scaling down to the neighborhood and property levels revealed absolute affinities for particular natural and social characteristics (Table 5). To guide our discussion, we focus on three tendencies which, although unlikely mutually exclusive, may have an impact on the long-term natural resources management and the social dynamics of these cities over time.

Table 6. Respondent characteristics for environmental variables.

Environmental measure (n)	Possible range	Mean (± SD)		r †	Eta
		Portland	Vancouver		
New Ecological Paradigm (1035)					
DSP	7-35	6.9 ± 2.6	8.2 ± 3.4	- 0.162*	0.267
NEP	8-40	31.4 ± 4.9	29.5 ± 6.1	0.178*	0.312
Catastrophe	5-25	19.1 ± 3.6	17.7 ± 4.3	0.176*	0.287
Nonintervene	5-25	19.8 ± 2.9	18.6 ± 3.6	0.174*	0.236
Ingenuity	4-20	10.1 ± 2.8	11.1 ± 2.7	- 0.730*	0.238
Value Orientations (1039)					
HumDom	4-20	6.9 ± 2.6	8.2 ± 3.4	- 0.209*	0.265
Protectionist	6-30	20.6 ± 4.2	20.0 ± 4.8	0.056	0.068
Nature (1076)	10-50	45.2 ± 5.1	43.9 ± 5.7	0.118*	0.226

† An asterisk (*) denotes a significant difference between locations at the 95% confidence level.

Fig. 1. Frequency of respondents who indicated importance of 15 landscape characteristics at the (a) property-level (at or next to my house), (b) neighborhood (within a 20-minute walk from my house), and (c) metro-level (across the metro area) scales. Portland responses are indicated by black squares; Vancouver responses are indicated by gray squares. An asterisk (*) indicates significant differences between the two cities for each characteristic at each scale. Significant differences across scales for each characteristic and for each city are indicated by P (Portland) and V (Vancouver).



First, preferences are segmented within the urban experience. Portland respondents illustrated affinity for proximity of urban services (e.g., public transportation, stores and services), whereas Vancouver respondents preferred amenities that require more physical space (e.g., plentiful accessible parking, streams and rivers). In Portland, county-wide transportation options include several automobile bridges over the Willamette River, limited-extent light rail, bike lanes, and commuter trains to suburbs, which together facilitate 25% of Portland workers using public, pedestrian, or bicycle transportation for work (USDC 2014). Extensive bus routes, such as those in downtown Portland also exist in Vancouver, but limited transportation infrastructure crosses the Columbia River (i.e., bus, car, Amtrak). Despite the constraints, 33% of Vancouver residents work out of state, e.g., in Oregon (USDC 2014), yet only 5% (USDC 2014) use public transportation, walk, or bicycle for transportation to work. As a result, parking is important for highly commuting-dependent Vancouver. In contrast, 78% of Portland residents work within Multnomah County (USDC 2014), and county-wide availability of public transportation may alleviate some importance of parking in Portland (Table 4). Perceptions of public transportation (e.g., Beirão and Sarsfield Cabral 2007) were beyond the scope of our data, yet compared to past research (Anable 2005) individual transportation preferences seem influenced by socioeconomics, at least for Vancouver (A.T. Morzillo, *unpublished data*).

Our results also suggest that Portland respondents prefer convenience across a variety of transportation modes. For instance, Portland respondent's affinity for stores and services may be influenced by a preference for walkability (Lo 2009, Carr et al. 2011). Direct relationships between access to multiple destinations (e.g., schools, public transit, stores) and walking for transport have been reported (McCormack et al. 2008, Brown et al. 2009). Walkability has also been linked to higher home values (Cortright 2009) and lower risk of obesity (Zick et al. 2009). Despite those findings, residents of low-walkable neighborhoods have attributed greater rankings to aesthetic characteristics, such as more hills, trees, shrubs, open space, and scenic views than those in high-walkable areas (Leslie et al. 2005). Such contrast may help explain Vancouver respondents' stronger affinity for streams and rivers and for greater importance of natural areas at the property scale (Fig. 1).

Nevertheless, affinity for nature-related characteristics existed among respondents from both cities, particularly tree-related variables for Portland respondents and vegetation along streams for Vancouver respondents. Benefits of urban trees and vegetation include reducing heat island effects (Grimm et al. 2008), stormwater management (Yeakley 2014), stress reduction (Carrus et al. 2015, Taylor et al. 2015), familiarity (Henwood and Pidgeon 2001), reduced crime rates (Kondo et al. 2015), carbon sequestration and pollutant reduction (McPhearson et al. 2013), and oxygen provision (Camacho-Cervantes et al. 2014). Relationships with particular socioeconomic conditions have been noted (Landry and Chakraborty 2009, Conway et al. 2011). Amid the urban experience, greenery as small as individual trees may provide a connection with nature for Portland residents, who are generally further from streams. In addition, the younger age and greater likelihood of having children for Portland respondents may suggest the role of urban parks for daily connection with nature (e.g., Payne et al. 2002, Balram and Dragićević 2005) and as social outlets for families and residents with dogs (e.g., Germann-Chiari and Seeland 2004, Grahn and Stigsdotter 2010, Schipperijn et al. 2010). Thus, preference for at least some urban nature exists along with willingness to forego proximity to natural areas for the convenience of transportation and consumer services.

Second, differences between the two cities also may be influenced by economics. Economic theory posits that, under certain conditions, citizens “vote with their feet” and move to communities that most closely align with their preferences for land-use policies, tax policies, and publicly provided goods (Tiebout 1956). Hence, Portland respondents' strong and consistent affinities for public transportation and stores and services across scales could be an unintended outcome of Oregon's more aggressive approach to land-use planning (Kline et al. 2014). Differences in tax policies between the two states (Philen 2014, Oregon Legislative Revenue Office 2015) may also contribute to Vancouver respondents' greater affinity for parking and less affinity for nearby stores and services (Table 5). Washington has no income tax, but it has a sales tax; Oregon has no sales tax, but relies heavily on income tax revenue. This diversity may lead to tax avoidance whereby Vancouver residents shop in Oregon to minimize sales tax, yet live in Washington to minimize income tax. However, testing this speculation is beyond the scope of our data.

Economic theory also implies that tax policies and amenities should be capitalized into the sale price of residential properties (Freeman 2003). Research applying the hedonic price technique has found that property sale prices in Portland are influenced by open space proximity (Lutzenhiser and Netusil 2001), type and proximity of wetlands (Mahan et al. 2000), walkability (Cortright 2009), and street trees (Donovan and Butry 2010). Therefore, from our results (Fig. 1), we hypothesized that a hedonic study using property sale data from Portland and Vancouver would find a higher marginal willingness to pay in Vancouver for well-manicured vegetation and vegetation along streams, and a higher marginal willingness to pay in Portland for the presence of large mature trees, tree-lined streets, public transportation, and stores and services.

Finally, personal relationship with the environment may contribute to the importance of landscape characteristics. Our results support our hypotheses that Portland respondents are more likely to have greater NEP scores than Vancouver respondents, and that Vancouver respondents exhibit more anthropocentric and use-based orientations than Portland respondents. Given these differences, we speculate that affinity for public transportation and proximity to stores and services among Portland respondents may be associated with a desire to be environmentally altruistic; yet, the literature is mixed in supporting this assertion. For example, Bopp et al. (2011) reported an inverse relationship between commuting time and average eco-friendly attitudes among young adults. However, public transportation usage and other environmentally related behaviors have been linked to not only personal environmental norms, but also emotional characteristics (Bamberg et al. 2007, Carrus et al. 2008). Specific to our objective, public transportation may support a theme of cognitive based, self-sorting of individuals between cities (Bamberg et al. 2007). Relatively greater scores for Nonintervene, Ingenuity, and HumDom among Vancouver respondents could reflect preferences for inventiveness versus inevitability (see Bamberg et al. 2007 for an example of potential segmentation based on industrial-postindustrial characteristics) and represent a combination of social relics and driving forces behind the different land-use planning models of the two states. Directly testing this assertion would require longitudinal analysis. Nevertheless, others have noted the role of time lags and land legacy in both inherited versus contemporary observed landscape characteristics (Boone et al. 2010).

A global view of the data provides further insight into metro-area dynamics, and similarities and interdependencies of the two cities as an integrated multiscalar system (Ostrom 2010, Liu et al. 2013). Commute patterns (USDC 2014) illustrate strong functional linkages between the two cities. Elsewhere in this study, data suggest that respondents may view particular environmental characteristics (e.g., water quality) of the “other” city as different than their own (A.T. Morzillo, *unpublished data*). However, influences of shared public dialogue and communication outlets (e.g., news media such as TV stations), strong interactions between professional groups (e.g., natural-resource managers, urban planners, and foresters), and geographic similarities may be more important than location of the cities in two different states (Sterrett et al. 2015).

Although the land-use planning histories of Oregon (i.e., safeguard economic production) and Washington (i.e., protect open space) differ in historical motivation, our results indicate some consistencies in resident perceptions between the two cities. Preliminary results of ongoing analysis suggest “Nature” (Table 3) to be the most consistent variable to influence the importance of all 15 landscape characteristics for both cities (A.T. Morzillo, *unpublished data*). Personal relationship with the environment is a consistent driver of support for decision making related to natural resource conservation (e.g., Morzillo and Mertig 2011*b*). However, individual preferences may be reflected in object-based attitudes (e.g., Morzillo and Mertig 2011*b*, Camacho-Cervantes et al. 2014, Belaire et al. 2016), reflect discourse among human perceptions of nature (Steinberg et al. 2015), and the influence of socioeconomics. For example, urban versus rural residence and more formal education are often correlated with variation in environmental concern (e.g., Van Liere and Dunlap 1980, Hayes 1989, Arcury and Christianson 1993, Dietz et al. 1998, Berenguer et al. 2005, Freudenburg 1991, Morzillo and Mertig 2011*a*, *b*, Newman and Fernandes 2016). In our case, homogeneity of our respondents as geographically "urban" (i.e., within the metropolitan area) may have influenced environmental predictors, as supported by generally high scale scores for NEP and equally for Protectionist. Although it is difficult to measure (Hawcroft and Milfont 2010) and directly compare our results to other locations, trends in NEP have increased over time in tandem with social environmental movements and rural-to-urban human population shifts (Dunlap et al. 2000, Inglehart and Baker 2000). In addition, more than 30% of those in the Portland-Vancouver-Hillboro consolidated metropolitan statistical area (2010 U.S. Census; USDC 2014) and our respondents (Table 4) were college graduates, which is greater than the population at large (USDC 2014) and disallows broader regional inferences. We also note overall demographic differences between our respondents and census data (USDC 2014) which, regardless of nonresponse follow-up, reinforce limitations in generalizing our results to the whole metropolitan area based on intent and use of our sampling strategy and data collection (Dillman et al. 2009). It is clear that there are multiple factors affecting decision making. Therefore, it is unlikely that uniform policies that assume homogeneity among preferences for urban landscape characteristics are appropriate.

CONCLUSION

Urban landscapes are the result of complex decisions made over multiple spatial and temporal scales. Although our data seemed homogeneous at the broadest scope, we detected nuances at multiple scales of analysis with the greatest differences generally at the property-level scale. The cumulative effect of property-level decisions affects landscape characteristics at coarser scales. Governance can overcome collective action problems that arise when individual decisions result in outcomes that are not optimal when viewed at a larger scale. In our case, historical and existing land-use policies may be contributing to self-fulfilling processes of actual development patterns over time, particularly in the case of Oregon. However, these patterns only occur at certain scales and among many competing factors. Inmigrants seeking regional geographic amenities may not differentiate between Portland and Vancouver. However, each city has its own social culture that takes time to develop, maintain, and further evolve depending on what trade-offs communities are willing to make. Further exploration of such relationships will likely support a broader story about how such patterns contribute to feedback loops over time.

Responses to this article can be read online at:
http://www.ecologyandsociety.org/issues/responses.php/8478

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