

ECOLOGICAL FUNCTION AND THE PERCEPTION OF SUBURBAN RESIDENTIAL LANDSCAPES

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Vernacular aesthetic expectations often limit the degree to which suburban residential landscapes enhance ecological function. Conventional lawns that are neat, weed-free, and recently mown may have little biodiversity or habitat value. Landscape design can enhance ecological function, but little is known about how people might perceive the aesthetic and maintenance characteristics of more ecologically sustainable alternatives. This project proposed a range of seven alternative suburban landscape treatments designed to meet vernacular aesthetic expectations while varying degree of ecological function. It then measured 234 suburban residents' perceptions of the proposed alternatives. While the results suggest that ecological knowledge profoundly affects perceptions and preferences for suburban landscapes, results also suggest that considerable latitude exists for designing suburban landscapes that greatly enhance ecological function and meet the aesthetic expectations of the general suburban population.

Suburban Landscape Aesthetics and the Ecology of the Lawn

Think of the suburbs and broad expanses of mown turf inevitably come to mind. For some this landscape of lawns is an inviting-- even reassuring --image, but for others it epitomizes the benign subjugation of nature. Although a tidy lawn may suggest that its caretaker is a courteous neighbor (Nassauer, 1988a), it can also suggest more sinister effects: pesticides and herbicides posing health risks for people and animals, fertilizer nutrient overloading of lakes and streams, and use of limited freshwater resources for lawn watering. Some companies in the "green industry" have responded to growing awareness of these effects with development of different varieties of turf grass that are more resistant to drought, pests, and weeds. Although this kind of change can improve some aspects of the environmental quality of suburban ecosystems, it does not address a fundamental problem related to the ecological structure and function of the suburban landscape: the failure of traditional lawn design to provide for biodiversity. The turf matrix does not provide for connection of environmental resource patches and the movement of species, and it accelerates surface water run-off rates and resultant aquifer depletion and downstream flooding. These effects have caused one observer, practiced in

ecological restoration, to assert that a permit should be required for making a lawn (Sauer, 1992).

The typical standard for local governments is quite the opposite. Local "weed" ordinances, intended to remedy situations in which property owners have neglected to care for their lawns, frequently have equated indigenous vegetation with weeds. Across the country, these ordinances impose a traditional mown lawn on homeowners who may want their yards to become meadows or prairie gardens. In fairness to the lawn innovators, local governments are struggling to codify the difference between a weedy, neglected lawn and an aesthetically acceptable suburban yard that is not dominated by turf. For example, several draft or recently adopted ordinances require a band of mown turf at the front or around the edges of a property (e.g., Montgomery County, Maryland; Minnetonka, Minnesota; Madison, Wisconsin). Others specify that meadows and prairie gardens be limited to native plants to be acceptable (e.g., White Bear Lake, Minnesota). Still others require that meadows and prairies be confined to the backyard. All struggle to identify the limits of a pervasive but largely implicit suburban landscape aesthetic.

Looking beyond the scale of the individual lawn, the suburban landscape can be seen as the great, spreading organism of western metropolitan structure. It surrounds cities, typically built at ecologically rich junctures or ecotones, along rivers or baysides. With the conventional landscape aesthetic one of biological homogeneity, the suburban landscape insulates these rich edges or points from the greater biodiversity of the surrounding countryside. In the face of global climate change, these suburban blankets of turf may become barriers to plant and animal species seeking to move along with shifting climatic bands (Peters & Lovejoy, 1992).

A central assumption of the project described here is that a more heterogeneous structure and greater biodiversity in suburban landscapes has ecological value. Perhaps it will reduce chemical and water use. More importantly, it will facilitate the movement of species across the landscape, create habitat patches, and increase aquifer recharge across a metropolitan region.

A second key assumption of the project is that the conventional neat, green, mown turf matrix of suburban landscapes is a powerful means of communicating care and neighborliness (Nassauer, 1988a, 1988b, 1992), and has great cultural value. The project tests alternatives for increasing the ecological quality of suburban landscapes while accepting the decisive nature of public perception in defining suburban landscape structure.

Hypotheses and Method

This project investigates how landscape structure and biodiversity might be increased in suburban residential landscapes while meeting vernacular aesthetic expectations.

Operational Definitions

Aesthetics is construed broadly here to mean what one enjoys seeing. It is not limited to concepts of the scenic or beautiful,

and it does include concepts of attractiveness, care, neatness, and naturalness.

Landscape structure is drawn from landscape ecology (Forman & Godron, 1986) and refers to:

- **Heterogeneity-** The more types of ecosystems (homogeneous plant communities) within a landscape, the greater the potential number of species.
- **Connectivity-** The more connected the landscape network of environmental resource patches and corridors, the greater the potential for movement of species.
- **Patch size-** The larger the environmental resource patch size, the greater the habitat value for interior species.

Biodiversity is operationalized in this project to mean both the number of indigenous plant species and the number of individuals of indigenous species within a landscape.

Hypotheses

The central hypothesis of the project is that if suburban landscapes are designed to include vernacular aesthetic cues, increased biodiversity and improved landscape structure can be aesthetically pleasing. Vernacular cues applied here are cues to care of the yard. A secondary hypothesis is that people who are knowledgeable about ecological systems are more likely to perceive increased biodiversity and improved landscape structure as attractive than are people who are less knowledgeable.

Study Sites

In this project, video-imaging simulations (Nassauer, 1990; Orland, in press; Pitt, 1990) were used to display seven experimental landscape treatments on each of four suburban sites in the Minneapolis-St. Paul metropolitan area. Each of the properties had been developed within the previous two years. Two of the properties (sites 1 and 2) had real estate values somewhat over \$200,000. Two properties (sites 3 and 4) had real estate values somewhat over \$100,000. Each treatment was displayed in the simulations from two perspectives: the view along the street, showing the larger landscape matrix; and the view of a single residential site on that street, directly facing the house. In each of the simulations, only the plant community and proportion of the site in turf was varied. The design of the subdivision, including topography and street and sewer infrastructure, were maintained in their conventional, *in situ* pattern. The planting plan was also held constant across the sites. Each of the treatments was simulated as it would look in August, fifteen years after planting.

Treatments

The seven experimental treatments ranged from a highly conventional treatment with a turf lawn and ornamental plants (treatment 1) to a design in which most of the turf had been replaced by indigenous plants of the oak savanna. One of the seven treatments was a variation on the conventional landscape plan, in which the landscape was shown as it would

look if it were not maintained (treatment 2). This kind of weedy lawn is the intended target of local ordinances that have frequently jeopardized indigenous plants on residential sites.

The remaining five treatments exhibited vernacular cues to care (Nassauer, 1992) while increasing the ecological quality of the planting design. Based on results from a number of previous projects in rural settings, preliminary interviews with Twin Cities suburban residents, and information from related projects elsewhere (e.g., Anderson & Schroeder, 1983; Morrison, 1981; Palmer, 1988; Schaumann et al., 1987; Smardon, 1988), the following vernacular cues were used in each planting design: the retention of at least some mown turf near the front and entry of the house, the use of foundation plantings, and the colorfulness of herbaceous cover (including a high percentage of showy forbs). This range of treatments began with a mown lawn and native canopy trees of oak, cedar, and aspen (treatment 3). Next, 50 percent of the mown turf was replaced with an herbaceous prairie plant mix heavily dominated by forbs (treatment 4). For the next treatment (5), 75 percent of the mown turf was replaced with an herbaceous prairie plant mix dominated by forbs. Treatment 6 showed 50 percent of the turf replaced with indigenous sumac and hazelnut shrubs. The final treatment (7) had the greatest heterogeneity, connectivity, patch size, and biodiversity, where 75 percent of the turf was replaced by a combination of indigenous shrubs and canopy trees, with prairie forbs shown along the edges.

Respondent Sample

The opportunity sample of respondents included 167 residents of third tier suburbs in the Minneapolis-St. Paul metropolitan area. To measure how knowledge of indigenous plant communities might influence perceptions, the sample also included another 67 people who belonged to the state native plant society or to a suburban citizens group concerned with the use of native plants. Respondents participated in the survey during one of eight group events: four meetings of suburban church groups, two meetings of local suburban governments, the annual meeting of the state native plant society, and a weekend-long event at the University arboretum. The mean age of the respondents was 44; about 60 percent were between the ages of 31 and 50. A little less than half (43%) were men, a little more than half (57%) women. About one third had at least some graduate school, and slightly more than one third had a high school education or less. Ninety percent of the respondents reported that their family spent an average of at least two hours per week doing yard work. Sixty percent reported that their family spent at least 4 hours per week doing yard work. Half (51%) reported that viewing wildlife from their home was very important to them.

Presentation of Simulations to Respondents

The respondents viewed color slides of the simulations and rated them on seven-point semantic differential scales. The simulations were viewed in two random orders, equally distributed between the two respondent groups. Five perceived characteristics were rated for each simulation:

attractiveness, care, neatness, naturalness, and amount of maintenance necessary. The first four characteristics fell within the working hypothesis of aesthetic quality and were hypothesized to be highly intercorrelated. The fifth characteristic, necessary maintenance, also was believed to be useful in predicting suburban dwellers' choices for their yards. The perceived characteristics were also randomly ordered on each of two different versions of the questionnaire, and each version was randomly distributed at each data gathering event.

Results and Discussion

Analyses of variance showed that neither slide order nor order of characteristics on the questionnaire produced significant differences in the normalized ratings of respondents. Anecdotal discussions with respondents after the survey indicated that some thought the treatments with more complete ecological function were more attractive on sites that had larger, more expensive houses. However, an analysis of variance showed no significant site effect in respondents' ratings of attractiveness, or any of the other characteristics. Rather, variation in perceptions was more directly related to variations in the landscape treatments, and to variations in respondents' knowledge of indigenous plant communities.

Aesthetic Characteristics

Comparing the aesthetic and maintenance characteristic ratings within and across treatments revealed some patterns suggesting what may be driving people's preferences for suburban residential landscapes. They also suggest how change in landscape structure might be designed to be more acceptable to suburban dwellers, and where the limits of acceptable change may lie.

Plots of the relative normalized means showed regular patterns of rating clusters across some of the seven treatments (Figure 1). For treatments 1-4, the means for attractiveness, care, and neatness perceptions tended to form one cluster, while the means for naturalness and maintenance formed another. Although the relative position of the clusters changed across treatments, indicating that the treatments were differentially perceived, the clusters themselves remained intact. For example, the conventional landscape (treatment 1) tended to be perceived as attractive, well-cared for, and neat, but not very natural and requiring relatively high maintenance. For the conventional landscape, all characteristics including maintenance also tended to be highly intercorrelated ($p < .01$).

The weedy landscape (treatment 2) on the other hand, tended to be perceived as unattractive, not well-cared for, and messy, but was seen as natural and requiring little maintenance. Furthermore, while attractiveness, care, and neatness were significantly intercorrelated; naturalness and required maintenance were not consistently correlated with the other characteristics.

The least of the ecologically improved treatments (3), was seen as attractive, well-cared for, and very neat. The native tree canopy and mown turf was seen as requiring a little less maintenance and being more natural than the conventional landscape, but less natural and requiring more maintenance

than the weedy landscape. Once again, ratings of attractiveness, care, and neatness tended to be highly intercorrelated for this treatment, but naturalness and required maintenance ratings varied.

As with the first three treatments, ratings of attractiveness, care, and neatness for treatment 4 also clustered together. But unlike the first three treatments, naturalness was also consistently intercorrelated with attractiveness, care, and neatness. Only maintenance did not have a statistically significant correlation with the other ratings. While the 50 percent prairie landscape was generally not perceived as being as neat as the conventional landscape or the landscape of savanna trees and turf, it was perceived as being at least as or slightly more attractive. Importantly, the 50 percent prairie landscape was also perceived as being distinctly more natural than any of the previous treatments (except the weedy lawn). On the average it was perceived as requiring less maintenance than the conventional lawn but more than the landscape of trees and turf. Responses to open-ended items and in post-survey discussions suggested that respondents thought that all of the colorful flowers shown in treatments 4, 5, and 7 would probably require a lot of maintenance. This may account for higher maintenance ratings for treatment 4.

This regular pattern of rating clusters began to break down after treatment 4, particularly with respect to the relationship of ratings of attractiveness, care, and neatness. In other words, the increased levels of ecological quality represented in treatments 5, 6, and 7 appeared to violate people's vernacular aesthetic conventions for suburban residential landscapes. For example, while treatment 5 was perceived as more natural and requiring less maintenance than treatment 4, the 75 percent prairie groundcover was also perceived as messy and much less attractive. All of the five characteristics measured were highly intercorrelated for this treatment.

Treatment 6 had the most disordered rating pattern of all the treatments. Correlations among the rating means were inconsistent among the 4 sites for attractiveness, care, and neatness. Naturalness and required maintenance were consistently intercorrelated; the treatment was perceived as requiring some maintenance but being quite natural. Overall, this 50 percent woody shrub treatment was perceived as unattractive, not well-cared for, and messy. Open ended responses and anecdotes suggested that some people may have perceived tall shrubs around a house as creating safety problems. They also described treatment 6 as "too closed in," "out of proportion for residential sites of this size," and "too dark inside the house."

Treatment 7 was the most ecologically complete plant community, but while it was generally perceived as being natural, it was also perceived as very messy and unattractive. Each of the five characteristics were significantly intercorrelated. It should be noted here that even this alternative, which had 75 percent cover of trees, shrubs, and prairie forbs, was not seen as being as messy or unattractive as the weedy lawn (treatment 2). The weedy lawn seems to be perceived as qualitatively different from any of the designs

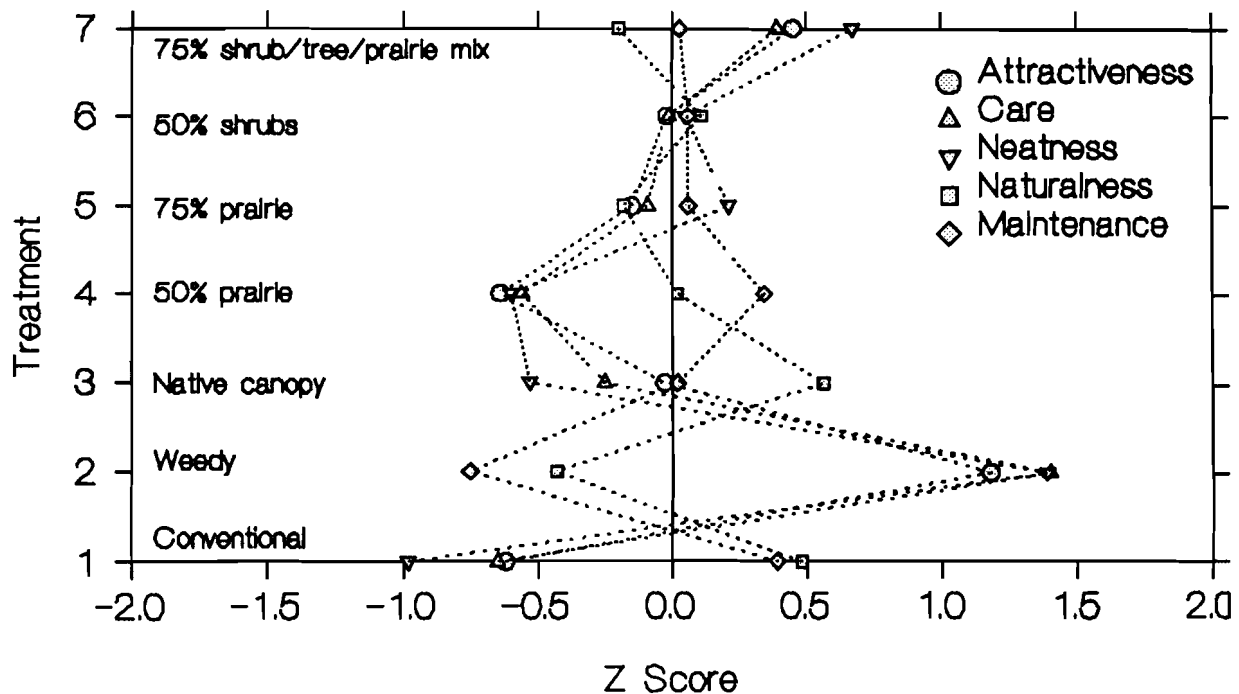


Figure 1. Pattern of relative normalized means for characteristics- all seven treatments for site 1.

for increased ecological quality.

Knowledge

Respondents who were knowledgeable about indigenous plants rated some landscape treatments very differently than did those who were less knowledgeable, but on other treatments the responses of the two groups were quite similar. This pattern of responses has interesting implications for local governments attempting to regulate "nuisance" lawns and to foster ecological quality. The responses also suggest some current limits for homeowners who wish to innovate with their lawns.

In all, each respondent rated 140 items-- five landscape characteristics for the four sites representing each of seven treatments. On all but 49 of those 140 items, mean ratings were significantly different for the knowledgeable and less knowledgeable groups (Table 1). The two groups differed markedly in their perceptions of the conventional lawn (treatment 1), and the two treatments where 75 percent of the turf was replaced by indigenous vegetation (5 and 7). In general, the conventional lawn was perceived as more aesthetically pleasing by respondents with no special knowledge of indigenous plants, while treatments replacing 75 percent of the turf tended to be perceived as more aesthetically pleasing by those with knowledge of indigenous plants. It appears that, within the context of this study, ecological knowledge does make a difference in perceptions of landscapes.

Similarities in the responses of the two groups offer some direction for governments and individuals wishing to increase

ecological quality while maintaining aesthetic quality. There was no significant difference between groups in their perceptions of the weedy lawn (treatment 2); both groups rated it the least aesthetically pleasing of all the treatments. Even those with less knowledge of indigenous plants found the weedy lawn less pleasing and distinct from the treatments replacing 75 percent of the turf (treatments 5 and 7). There was also no significant difference between the two groups in their ratings of treatment 6; these scenes showing 50 percent of the turf replaced by indigenous shrubs were generally perceived as aesthetically displeasing by both groups.

Most instructive, however, was the finding that there was no significant difference between groups in their ratings of treatment 4, where 50 percent of the turf was replaced by herbaceous prairie vegetation. Despite the fact that the less knowledgeable respondents found the conventional lawn (treatment 1) most attractive, and the more knowledgeable respondents found the treatment that replaced 75 percent of the turf with prairie (treatment 5) most attractive, this moderate treatment level appeared to have broad aesthetic appeal.

Conclusions

These results imply that if individuals or governments want to increase the ecological quality of suburban residential landscapes, there are some aesthetically acceptable ways to change. They suggest that to be publicly acceptable, ecological practices must be designed to pay special attention to vernacular cues to care. Design that maintains aesthetic quality should include prominent mown areas in front of patches of indigenous plants. As a general guideline, these

Table 1. Mean normalized ratings of aesthetic characteristics by knowledgeable (n= 67) and less knowledgeable (n= 177) participants, Sites 1-4.

SITE 1					
Ratings	Attract	Care	Neat	Natural	Maint.
<u>Treatment:</u>					
Conventional	.21 [*] -.96	-.26 [*] -.82	-.61 [*] -1.13	.95 [*] .27	.88 [*] .20
Weedy	1.05 1.22	1.38 1.43	1.68 [*] 1.30	-.29 [*] -.50	-.85 -.72
Canopy	.57 [*] -.27	-.05 [*] -.33	-.31 [*] -.62	.92 [*] .42	.47 [*] -.15
50% Prairie	-.65 -.66	-.57 -.56	-.55 -.61	.06 -.01	.22 .37
75% Prairie	-.83 [*] .15	-.47 [*] .07	-.27 [*] .40	-.62 [*] .01	-.15 .15
50% Shrubs	.16 -.09	.13 -.06	.18 -.00	.02 .13	.08 .06
75% Prairie and Shrubs	-.12 [*] .66	.14 [*] .48	.48 [*] .74	-.46 [*] -.10	-.38 [*] .19

SITE 2					
Ratings	Attract	Care	Neat	Natural	Maint.
<u>Treatment:</u>					
Conventional	.31 [*] -1.06	-.30 [*] -1.01	.72 [*] -1.22	1.13 [*] .29	.95 [*] .19
Weedy	1.05 1.09	1.74 [*] 1.42	1.45 [*] 1.21	-.03 [*] -.43	.94 -.80
Canopy	-.20 [*] -.88	-.56 [*] -.90	-.86 -1.01	.91 [*] -.04	.67 [*] -.24
50% Prairie	-.75 -.51	-.87 [*] -.46	-.73 [*] -.47	-.39 [*] -.03	.31 .26
75% Prairie	-.76 [*] .12	-.34 [*] .05	-.10 [*] .30	-.82 [*] -.15	-.33 [*] .21
50% Shrubs	-.37 -.43	-.23 [*] -.50	-.10 [*] -.38	-.30 -.20	-.17 -.04
75% Prairie and Shrubs	-.50 [*] .17	-.43 [*] -.04	.10 .35	-.84 [*] -.17	-.34 [*] .36

SITE 3					
Ratings	Attract	Care	Neat	Natural	Maint.
<u>Treatment:</u>					
Conventional	.56 [*] -.56	-.22 [*] -.67	-.74 -.79	1.04 [*] .56	.91 [*] .42
Weedy	.87 [*] 1.16	1.41 1.46	1.47 [*] 1.20	-.45 [*] -.51	.88 -.73
Canopy	.29 [*] -.44	-.17 [*] -.47	-.55 -.60	.78 [*] .07	-1.08 [*] -.09
50% Prairie	-.59 [*] -.30	-.59 -.36	-.53 [*] -.22	-.18 .05	.23 .26
75% Prairie	.55 [*] .44	-.13 [*] .51	.38 [*] .68	-.83 [*] -.24	-.51 [*] -.03
50% Shrubs	.12 -.00	.06 -.15	.00 .01	.26 .18	-.20 [*] .11
75% Prairie and Shrubs	-.48 [*] .40	-.17 [*] .50	.26 [*] .77	-.78 [*] -.20	-.64 [*] .09

SITE 4					
Ratings	Attract	Care	Neat	Natural	Maint.
<u>Treatment:</u>					
Conventional	.52 [*] -.33	.05 [*] -.44	-.18 [*] -.56	.95 [*] .42	.52 [*] .14
Weedy	.94 [*] 1.19	1.46 1.42	1.40 1.20	-.06 [*] -.31	-.68 -.57
Canopy	.45 [*] -.04	.10 [*] -.32	-.40 [*] -.66	.66 .40	.35 [*] -.36
50% Prairie	-.50 -.50	-.45 -.40	-.53 -.39	-.33 [*] .11	.34 .34
75% Prairie	-.61 [*] .13	-.55 [*] .00	-.29 [*] .24	-.81 [*] -.08	-.30 [*] .30
50% Shrubs	.11 .16	.14 .05	.09 [*] -.00	.00 .12	.08 [*] -.20
75% Prairie and Shrubs	-.31 [*] .16	-.25 [*] .11	-.08 [*] .26	-.51 [*] -.06	-.06 [*] .31

^{*}p < .01

mown areas should cover at least half the front yard.

The indigenous species should emphasize colorful flowers and conventional foundation plantings. Additional elements of the local vernacular should also be sought. For example, in this project we may have increased perceived aesthetic quality by simulating indigenous trees in a more conventional street tree pattern.

Furthermore, the results suggest that there are identifiable limits to the degree of change that will be generally aesthetically acceptable-- replacing 50 percent of the turf with a colorful range of prairie plants may be acceptable, but replacing 75 percent of the turf with those same plants may not. However, even replacing 75 percent of the turf will be perceived more positively than a weedy lawn, the intended target of local weed ordinances.

Public perceptions also are likely to evolve with increased knowledge of indigenous ecosystems. What looks weedy to most people today may look beautifully diverse as people learn more about the function and sustainability of ecologically designed landscapes. One way that people will learn how to appreciate biological diversity and rich landscape structure is by seeing it in suburbs that encourage people to begin to innovate. Innovations that are designed with vernacular cues to care will undoubtedly ease the transition to greater ecological awareness.

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