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MONITORING THE SUCCESS OF METROPOLITAN WETLAND RESTORATIONS: CULTURAL SUSTAINABILITY AND ECOLOGICAL FUNCTION

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Abstract: In an interdisciplinary project to develop protocols for long-term cultural and ecological monitoring of wetland restorations in Minnesota, we compared restored and reference wetlands on several ecological and cultural measures including land-use context, cultural perceptions, and management practices. Cultural measures were drawn from our surveys of visitors, neighbors, planners, and managers of the wetlands. This paper discusses their perceptions of six metropolitan wetlands (four recent restorations and two reference sites), how cultural measures of their perceptions compared with selected site characteristics and biodiversity measures, and what results suggest for wetland design and management. Overall, sites that were perceived as more well-cared-for and as a good place to enjoy nature were perceived as more attractive. In addition, objective site characteristics, like cultural cues and natural landscape context, were related to perceived attractiveness. While plant species richness was not significantly related to perceived wetland attractiveness for our sites, bird species richness was related to attractiveness.

Key Words: public, perception, maintenance, management, monitoring, biodiversity, urban

INTRODUCTION

Wetland restoration takes place in a cultural context in which designers' and managers' restoration decisions are affected by broader public values, and informal management decisions by adjacent landowners can affect wetland vegetation and hydrology (Guntenspergen and Dunn 1998, Mensing et al. 1998, Kelly 2001, Kaplowitz and Kerr 2003). In a project monitoring restored and reference wetlands in Minnesota, USA, we addressed the question of how the perceptions and expectations of the public could affect ecosystem recovery, as well as questions about the ecological function of these same sites (Galatowitsch et al. 1999, Lehtinen and Galatowitsch 2001, Bohnen and Galatowitsch pers. comm.). This paper describes how visitors, neighbors, maintenance staff, and administrators of six metropolitan (Minneapolis-St. Paul) wetland sample sites perceived them, and it suggests possible solutions to restoration problems of public perception.

A central premise of this investigation of cultural perceptions is that, in a world dominated by humans, landscapes that are perceived as attractive are more likely to be sustained over time by human behavior (Nassauer 1997). While some indigenous ecosystems, like streams, lakes, and their surrounding landscapes, are likely to be widely perceived as attractive, others like wetlands and prairies are less likely to be immediately appreciated (Zube 1974, Herzog 1985, Schrader 1995, Bixler 1997, Ryan 1998, Decamps 2001, Nassauer et al. 2001, Bright et al. 2002, Kaltenborn and Bjerke 2002, Williams and Cary 2002). Just as wetlands seemed desolate and frightening to Europeans traveling in Midwestern American in the 19th century (Prince 1997), contemporary Americans may see wetlands as unkempt and unsafe (Buss 1994). Urban wetlands often display evidence that wetlands are used as dumping grounds even today. Even constructed wetlands may fail to meet cultural expectations for attractive landscapes (Debo and Ruby 1982, Smardon 1983, Baxter et al. 1985, Herzog 1985, Ferguson 1998).

Several cultural values for the appearance of landscapes may deter wetland appreciation. Surprisingly, what people enjoy as the appearance of nature may have little inherent relationship with its ecological quality (Nassauer 1992, Mozingo 1997, Daniel 2001, Gobster 2001, Hull et al. 2001). Rather, people typically associate nature with picturesque landscape characteristics like open water, woodlands with grassy openings, hills, and mountains (DeLucio and Mugica 1994, Nassauer 1995, Múgica and DeLucio 1996). Wetlands are not part of this canon of picturesque na-

ture, but they may borrow from public appreciation of these picturesque characteristics. The shape and open water characteristics of wetlands made a difference in the price that Portland, Oregon residents paid for homes near wetlands (Mahan et al. 2000). While nearness to non-linear open water wetlands was associated with increased house value, nearness to linear wetlands and scrub-shrub wetlands was associated with decreased home value. Home value increased only where nearby wetlands had unmistakably picturesque characteristics.

Typically, the appearance of wetlands contradicts cultural values of neatness and apparent care, as well (Nassauer 1988, Hull et al. 2001, Dutcher et al. 2004). To many, a pristine wetland (particularly a wetland that seldom has open water) may look weedy; it may look like an abandoned place that no one is maintaining (Prince 1997). Even for two relatively large (1.7 hectares and 4.3 hectares) open water, storm-water detention urban wetlands in southern Ontario, visual problems like murky water, nearby garbage, and weeds were the leading concern of 200 neighbors (Baxter et al. 1985). Such perceptions may lead to management ''improvements'' that mow, incrementally fill, kill ''weeds,'' and undermine the ecological services of wetlands.

Wetlands also may contradict a broader cultural value for landscapes—the need for a sense of control (Tuan 1984, Nassauer 1988, Francis 1989, Syme et al. 2001). Control may encompass a need to prune and mow, remove unfamiliar plants, or control flooding, as well as concerns about safety—getting lost, drowning, or vulnerability to hidden predators (Schroeder and Anderson 1984, Baxter et al. 1985, Buss 1994, Nassauer et al. 2001). Possibly related to concerns about safety, Syme et al. (2001) found that having children was the strongest predictor of nearby wetland visitation by families in Australian suburban neighborhoods; families with children were less likely to visit wetlands.

Picturesque nature, neatness, care, control, and safety are each cultural values for landscape appearance. The theory of cultural sustainability suggests that wetlands that are valued for their appearance are more likely to exist over the long-term in a human-dominated landscape (Nassauer 1997, Decamps 2001, Robertson and Hull 2001). Cultural sustainability means long-term ecological health that is perpetuated by cultural values and behaviors (Nassauer 1997). When the appearance of the landscape elicits human perceptions and behaviors that maintain its ecological health, the landscape could be described as culturally sustainable; a landscape that people enjoy or are proud of is more likely to be culturally sustainable. For example, if neighbors see a wetland as unattractive, they may change its periphery, its vegetation, and surface hydrology to create a landscape they find more attractive, or they may pressure maintenance staff and administrators to make these changes. If, on the other hand, they perceive the wetland as attractive, some may even be drawn to become familiar with plants and wildlife that contribute to its biological integrity, or they might manage their own property in a way they believe enhances the biological integrity of nearby wetlands (e.g., reduced mowing, fertilizers, herbicides, pesticides).

Attitudes, values, and knowledge of the public and decision-makers also can affect cultural sustainability (Nassauer 1993, Sugiyama 2000, Bright et al. 2002, Manuel 2003, Dutcher et al. 2004). Viewers who know more about wetland function or have attitudes and values in support of nature may recognize the beauty of some wetlands that the broader public might see as unattractive. Cultural sustainability simply recognizes the powerful effect of human perceptions, values, attitudes, and habits on the viability of restored wetlands. It recognizes the potential for the public to become watchful caretakers of restored wetlands—if they recognize value in the landscape they see.

As early as 1978, The International Reference Group on Great Lakes Pollution from Land Use Activities noted that techniques to protect water quality would ''require a high degree of public acceptance not only to ensure the commitment of municipal officials, but also to maintain the long term integrity of these measures.'' For restoration projects of all sorts, the importance of building in cultural benefits, including economic benefits, has been widely recognized (Daily 1993). The U.S. Environmental Protection Agency (2000) has declared that, ''Probably the most important factor which impacts all aspects of constructed wetlands is their inherent aesthetic appeal to the general public,'' (p. 7).

Cultural sustainability must be designed into wetland restorations and their management (Zedler and Leach 1998). Restorations that are conceived solely to mimic reference ecosystem conditions may not be valued by people who do not value, understand, or recognize those conditions (Jordan et al. 1987). Similarly, if storm-water wetlands are constructed solely to achieve their storm water management functions and are not immediately attractive, they may not be valued by people who live nearby. Past investigations of the effects of cultural cues (Manning 1979, Nassauer 1995, Kuo et al. 1998, Westphal 1999, Hull et al. 2001, Hands and Brown 2002, Matsuoka 2002, Williams and Cary 2002) suggest that wetlands that are designed and managed to display recognizable, valued landscape characteristics are more likely to be sustained by human behavior over the long term. Drawing

Table 1. Area (in hectares), landscape context, and presence of cultural sustainability cues for the six metropolitan wetland sample sites.

	Reference	Unplanted	Planted
Urban sites	0.75 ha. Natural landscape context Cues	0.09 ha. Not natural context No cues	0.34 ha. Not natural context Cues
Exurban sites	3.30 ha. Natural landscape context Cues	8.61 ha. Natural landscape context No cues	2.48 ha. Not natural context Cues

on this principle, the broad hypothesis of this investigation is that perceived attractiveness of urban wetlands is *not* necessarily related to biological integrity. Rather, I hypothesized that wetlands and wetland restorations would be perceived as more attractive if they were perceived as picturesquely natural, well-cared-for, or safe. In addition, I hypothesized that the following landscape characteristics would enhance the perceived attractiveness of metropolitan wetlands:

- A landscape context that clearly labeled the wetland as part of a natural area (e.g., part of a nature reserve or a larger ($>$ 8 ha.) wetland).
- The presence of cultural cues to the picturesque aesthetic, including noticeable wildlife. rolling terrain, and open water.
- The presence of cultural cues to the care aesthetic, including plants with vivid flowers, a highly visible mown area in the foreground of public entry or roadway, few plants that are perceived as weeds, signage that indicates human presence or intention to care for the wetland, and structures, like walks or seats, that are well-maintained and invite human presence.

METHODS

Wetland Sample Sites

We selected six wetlands in the Minneapolis-St. Paul, Minnesota, USA metropolitan portion of our larger study (Table 1). Two of these are natural reference wetlands, two are unplanted wetland restorations, and two are planted wetland restorations; one of each set is in an urban context and one in an exurban, metropolitan fringe context. We chose the sites to control soil characteristics that could affect ecological integrity.

As part of our plan for long-term monitoring of these sites, we chose only restorations that had been established in the year prior to data-gathering, and we conducted our initial application of the monitoring instruments to establish a data baseline. Consequently, cultural perceptions of these restored wetlands may have been less positive than they would be in later years. Newly seeded vegetation can look barren to the casual observer, and planted seedlings tend to be mixed with annual weeds in the first year. In addition during our data gathering, one site, the urban planted restoration, awaited construction of a boardwalk that was a key part of its design.

Sample wetlands had several characteristics related to the hypothesis about landscape characteristics (Table 1). Two of the wetland sites were set inside large nature reserves, and waterfowl were frequently visible. A third site, exurban unplanted, was more than twice as large any other (8.2 ha); I anticipated that it would be perceived as a distinct natural area by virtue of its size. All three of these sites were coded as positive for a binomial independent variable, natural landscape context. I also coded four of the six metropolitan sites positive for another binomial independent variable, cultural cues to care or the picturesque. The exurban planted site had newly constructed structures, including walks and seats, and was set in rolling terrain. The urban planted site had many plants with highly visible flowers and frequently visible waterfowl. Both of the reference wetlands were set in protected natural areas, where signs indicating their protected status were prominently displayed, another cultural cue (Table 1). All of the five sites that were coded positive for either context or cultural cues also had prominent areas of perennial open water within the wetland, a cultural cue for the picturesque aesthetic. However, because it was present in all except the urban unplanted site, which had other unique, confounding characteristics as well, open water was not directly measured as a variable in this analysis. In addition to lacking open water, the urban unplanted site was not visible from any public road or walk, suggesting that it might not be perceived as safe.

Monitoring Protocols and Public Perception Sample

Our team developed long-term monitoring protocols and monitored hydrology, water chemistry, soils, vegetation, amphibians, fish and birds, land-use context, and cultural perception and management of the sites in 1998. All of the monitoring protocols, detailed site and land-use context descriptions, and 1998 data and

Table 2. Species richness for each site in summer 1998—in the first year after planting of non-reference sites.

Wetland Type	Reference		Unplanted		Planted	
Species Counted	Plant	Bird	Plant	Bird	Plant	Bird
Urban sites	71	15	77	3	94	3
Exurban sites	127	16	77	27	173	12

results are included in Galatowitsch et al. (1999). To test whether biological characteristics that were clearly visible would be related to public perceptions of wetland attractiveness, I used my colleagues' counts of the number of bird species and plant species present on each site in the summer of 1998 in this analysis (Table 2).

I developed the cultural monitoring protocol to characterize how people perceived specific wetland sites that they knew and how these perceptions and behaviors could affect restoration recovery. Perception and management data were collected from four groups in 1998 (visitors, neighbors, administrative managers, and maintenance personnel) (Table 3). Data were gathered on questionnaires that included some of the same perception items for all sample groups and different items related to behavior and management choices specific to each group. Questionnaires included both forced answer and open-ended items. Forced answer questions included seven-point bi-polar adjective interval scales (e.g., ranging from ''very well cared for'' to ''very poorly cared for'') measuring each respondent's perception of ''attractiveness,'' ''care,'' ''safety,'' ''a place to enjoy nature,'' and ''a place for children to have fun.'' The forced answers also included five-point objective ordinal scales about how often respondents had seen wildlife at or near the wetland. (e.g., ranging from ''never'' to ''always''). Open-ended items asked all respondents to describe what made a place attractive or unattractive. Managers (administration and maintenance) were asked many more open-ended questions and provided forced answer ratings for only the dependent perception variable, attractiveness.

Table 3. Mean attractiveness ratings of wetlands (1—high to 7—low) by four sample groups (n) for the six metropolitan Minneapolis St. Paul, MN, USA, wetland sites in 1998.

Perception	Wetlands Type		
Sample Groups	Reference	Unplanted	Planted
Urban Sites			
Visitors	2.4 (17)	2.5 (2)	3.1 (27)
Neighbors	1.8 (11)	4.6 (13)	2.7 (10)
Administrator	4.0 (1)	3.6 (5)	3.3 (6)
Maintenance	3.0 (2)	(0)	3.5 (2)
Exurban Sites			
Visitors	2.1 (22)	3.0 (2)	2.4 (13)
Neighbors	3.1 (9)	2.0 (5)	2.0 (8)
Administrator	1.0 (1)	2.0 (2)	2.5 (4)
Maintenance	2.0 (2)	(0)	2.0 (3)

To interview and observe visitors, trained field teams of one or two people gathered data on each wetland site that had visitors between 11 a.m. and 6 p.m. on three separate non-rainy days from July to September. They conducted 5–10 minute interviews to complete the questionnaire with every visitor who was willing to participate; 83 visitors were interviewed. However, only two people visited each of the unplanted metropolitan sites over the course of data collection. In fact, we learned from our interviews and site observation that the urban unplanted site, which was not visible from any public road or pathway, was used by people who did not want to be seen by local police or others. The two visitors to that site stayed there most of one day we interviewed them.

To collect data on the perceptions of wetland neighbors, our research team used city maps and county plat books to develop a mailing list that identified all landowners within two blocks of each urban site, and within 3.2 kilometers of each exurban site. Questionnaires were mailed to 123 metropolitan landowners, and 56 useable questionnaires were returned (45% return rate). Administrators (including planners and designers) of each metropolitan wetland were interviewed by telephone or in office visits; 19 were interviewed. Staff who maintained the wetlands and their surroundings were identified through their supervisors and information postings at their place of work and were interviewed at the wetland site; nine were interviewed.

Data Analyses

The dependent variable, perceived wetland attractiveness, was examined in relationship to respondent group membership (Table 3), respondent perceptions of other cultural values (e.g., care, safety, a place to enjoy nature, a place for children to play), respondent perceptions of objective site phenomena (e.g., relative frequency with which wildlife were observed), objective characteristics of the wetlands (Table 1), and measures of biodiversity selected to include measures that might be visible to the general public: bird and plant

Table 4. Cultural perception variable Pearson correlations for the neighbor sample group (n = 50–54).

	Attractive	Care	Place to Enjoy Nature	Place for Children to Play	Safe
Care	0.739**	1	0.663**	0.694**	0.800**
Place to enjoy nature	0.788**		1	0.697**	0.680**
Place for children to play	0.721**			1	0.641**
Safe	0.680**				1

** Two-tailed significance $p < 0.01$.

species richness (Table 2). For the analysis, all variables except the biodiversity measures were scaled so that lower values indicate more desirable characteristics (e.g., 1 = most attractive, 7 = least attractive; 1 = always see wildlife here, 5 = never see wildlife here). Biodiversity measures are species counts, in which larger values indicate greater species richness.

The significance of sample group on perceptions of wetland attractiveness was tested by a univariate analysis of variance (ANOVA). Since the administrator and maintenance groups were much smaller subsamples and shared only the forced answer quantitative attractiveness item with the neighbor and visitor questionnaires, further quantitative analysis focused on the neighbor and visitor groups. T-tests for independent samples were run to compare these two groups' perceptions of attractiveness for each of the metropolitan wetland sites. Pearson correlations among all of the cultural value variables, including attractiveness, were calculated for each group separately and measured by two-tailed tests of significance. Keeping the visitors and neighbors separate, T-tests for independent samples were run to test for the effects of each the binomial landscape characteristics (landscape context and cues) within each group. For each group, correlations between the frequency with which they reported viewing wildlife and potentially related objective measures (bird species richness, plant species richness, and natural landscape context), were also calculated and tested for statistical significance. Based on the results of the correlation analyses of the cultural perception variables, the highly intercorrelated cultural perception variables for the neighborhood group were reduced by a principal components factor analysis for each group (SPSS v.11.5, SPSS, Inc.) to more succinctly express relationships among the independent variables of the data set (Gorsuch 1983). Only factors with Eigenvalues over 1.0 were interpreted and used for subsequent analysis, in which the factors were regressed on the dependent variable, attractiveness. Finally, a linear regression model, for which both the factors and simple unreduced independent variables were tested as predictors of attractiveness, was constructed for each group. Only independent variables with $p<0.05$ were entered into each stepwise regression model. I used stepwise regression to complement the previous analyses, which examined relationships among pairs of individual variables; the stepwise technique identified individual independent variables (or factors) that most powerfully predicted attractiveness, given that interrelationships may exist among the independent variables. Results of these quantitative analyses are discussed below in light of a summary from the content analysis of responses from all four groups to open-ended questions about what made each site attractive or unattractive.

RESULTS AND DISCUSSION

In a comparison of the four sample groups' perceptions of metropolitan wetland attractiveness by ANOVA, ''group'' made a significant difference in perceptions ($n=164$, $df=160$, F 38.72, $p<0.000$). Note that ranking of mean ratings among groups varies from site to site (Table 3). In some cases, like the unplanted urban restoration, neighbors were more harsh judges of wetland attractiveness. In other cases, like the urban reference site, the administrator was the harshest judge of attractiveness. Beyond concluding that visitors, neighbors, administrators, and maintenance staff tend to have distinctly different perceptions of attractiveness for the same wetlands, no trends in the perceptual habits of these different groups can be inferred from these data alone.

The neighbor and visitor subsamples were sufficiently large to allow more detailed comparisons of their attractiveness perceptions. T-tests comparing independent samples of visitors' and neighbors' perceived attractiveness for each of the reference and planted restoration metropolitan wetland sites individually did not indicate a significant difference ($p>0.35$ for the T-tests for all sites) between the visitors and neighbors. The very small samples of visitors to the unplanted sites, which drew almost no visitors (two to each of the two metropolitan unplanted sites over the course of three sampling days), made a statistical test invalid for those sites. However, other cultural perception variables that were correlated with perceived attractiveness varied markedly between the visitor and neighbor groups (Tables 4 and 5). While each of the

Table 5. Cultural perception variable Pearson correlations for the visitor sample group (n = 82).

	Attractive	Care	Place to Enjoy Nature	Place for Children to Play	Safe
Care	0.470**	1	0.286**	0.187	0.096
Place to enjoy nature	0.382**		1	0.214	0.220*
Place for children to play	0.247*			1	0.107
Safe	0.211				1

** Two-tailed significance $p < 0.01$.
* Two-tailed significance $p < 0.05$.

other cultural perception variables that I expected to be related to attractiveness (care, safety, naturalness, and a good place for children to play) were highly intercorrelated for the neighbor sample group (Table 4), there were few statistically significant correlations ($p<0.05$) among the independent perception variables for the visitor sample (Table 5) excepting correlations with the dependent variable, attractiveness.

Cultural cues (Table 1) seem to strongly influence perceptions of wetland attractiveness. Since almost no visitors visited the two wetlands that did not have cultural cues, I analyzed no data for visitors. However, the fact that so few visitors came to the wetlands lacking cues to care might be construed to imply that visitors did not find these sites attractive. Neighbors of the wetlands with cultural cues perceived them as significantly more attractive ($n=54$, $t=-2.989$, $p<0.05$), a better place to enjoy nature ($n=54$, $t=-2.647$, $p<0.05$), more well-cared-for ($n=53$, $t=-3.361$, $p<0.05$), safer ($n=53$, $t=-2.669$, $p<0.05$), and a better place for children to play ($n=50$, $t=-2.756$, $p<0.05$), than did neighbors of the wetlands without cues.

Natural landscape context (Table 1) was important to both visitors' and neighbors' perceptions of wetlands. Both visitors and neighbors found wetlands in a natural landscape context significantly more attractive (visitors $n=82$, $t=-2.208$, $p<0.05$; neighbors $n=52$, $t=-2.674$, $p<0.05$), and both groups perceived natural landscape context wetlands as a significantly better place to enjoy nature (visitors $n=82$, $t=-3.660$, $p<0.05$; neighbors $n=54$, $t=-3.471$, $p<0.05$) and significantly more well-cared-for (visitors $n=82$, $t=-2.307$, $p<0.05$; neighbors $n=52$, $t=-2.114$, $p<0.05$). There was not a significant difference in either visitors' or neighbors' perceptions of the natural context wetlands as better as a place for children to play. However, neighbors to the natural context wetlands did see them as significantly safer than did neighbors of the other wetlands ($n=53$, $t=-2.329$, $p<0.05$), while for visitors there was no significant difference.

Consistent with the overarching hypothesis that perceived attractiveness is not necessarily related to biological integrity, I anticipated that respondents' reports of the frequency with which they observed wildlife would not necessarily be related to my colleagues' measurements of bird or plant species richness. However, visitors' reports of the frequency with which they saw wildlife were highly correlated with both bird species richness ($n=83$, Pearson's $r=-0.247$, $p<0.05$), and plant species richness ($n=83$, Pearson's $r=-0.305$, $p<0.01$). Visitors did not report seeing wildlife significantly more frequently for wetlands in a natural landscape context, while neighbors did ($n=54$, $t=-3.435$, $p<0.05$), and their reports of observing wildlife were significantly correlated only with bird species richness ($n=56$, Pearson's $r=-0.446$, $p<0.01$) and not at all with plant species richness. Interestingly, the natural landscape context sites did have higher average bird species richness than the other sites, but they actually had lower average plant species richness (Table 2). The planted sites, neither of which were in a natural landscape context, had been planted with many species, but at least in the first year after planting, they did not attract more species of birds.

Because these analyses indicated that visitors and neighbors had different values and observations underlying their perceptions of wetland attractiveness, I constructed different linear regression models for each group, exploring possible relationships between their other cultural values and the actual species richness of each wetland, and their perceptions of site attractiveness. I included the same cultural perception variables (Table 4 and 5), the same site characteristics (Table 1), and the same measures of bird and plant species richness (Table 2) in each of the two models.

Neighbors' perceptions of the attractiveness of metropolitan wetlands were strongly predicted by the cultural perception variables. Of the site and species richness variables, only bird species richness contributed to predicting perceived attractiveness and did so only marginally (Tables 6 and 7). Note that neighbors' perceptions of metropolitan wetlands as a place to enjoy nature, a good place for children to play, and well-cared-for accounted for 78.9% of the variation in their perceptions of attractiveness (Table 6).

Also, note in Table 4 that, for neighbors, the cultural

Table 6. Stepwise linear regression of cultural perception variables, site variables, and species richness variables on perceived attractiveness by neighbors of wetland sites.

Model Predictors (with constant)	Adjusted R Square	Degrees of Freedom 2	Significance of F Change
Place to enjoy nature	0.682	45	.000
Place for children to play	0.762	44	.000
Care	0.789	43	.014
Bird species richness	0.808	42	.027

perception variables that predict attractiveness are highly intercorrelated. Consequently, these variables were reduced in a principal components factor analysis of the cultural perception variables for neighbors. This produced only a single factor with an Eigenvalue over 1, which accounted for 77.76% of the variance in all four cultural perception variables. Loadings of the four variables on this factor were well-cared-for (0.91); a place to enjoy nature (0.87); looks safe (0.89); and a good place for children to play (0.86). Using this cultural factor, I created another linear regression model (Table 7), in which this factor alone predicted 76.7% of the variance in neighbors' perceptions of wetland attractiveness. Only bird species richness added significantly but marginally to the model. Both the raw variable model (Table 6) and the single cultural factor model (Table 7) were powerful in predicting neighbors' perceptions of wetland attractiveness.

The relationship of attractiveness with cultural perception variables, site variables, and species richness variables was different for visitors. Only care and ''a good place to enjoy nature'' were highly correlated with the dependent variable attractiveness (Table 5), and only those variables met the criterion for inclusion ($p<0.05$) in a stepwise linear regression model that tested all the cultural perception, site, and species richness variables (Table 8). This model was relatively weak (adj. $R^2 = 0.27$) in predicting visitor perceptions. While the perception of care alone did predict 21.1% of the variation in perceived attractiveness, only one other variable, a good place to enjoy nature, met the criterion for inclusion in the model. For visitors, what consistently mattered the most was that the wetland site appeared to be well-cared-for.

Overall, the results are consistent with the hypotheses. In addition, results suggest that people who have different experiences of wetlands—as visitors, neighbors, maintenance staff, or designers and administrators—may have distinctly different perceptions. However, detailed analysis of visitor and neighbor perception data also uncovered some perceptions shared by both of these groups. Related to the broad hypothesis that perceived attractiveness of urban wetlands is *not* necessarily related to biological integrity, bird species richness was significantly related to both neighbors' and visitors' perceptions of wetland attractiveness, and greater bird species richness was significantly related to both groups' reports of seeing wildlife more frequently. However, plant species richness was not significantly related to attractiveness for either group, and only visitors reported seeing wildlife significantly more frequently in sites that had greater plant species richness. In responses to the open-ended questionnaire items, both neighbors and visitors identified wildlife more frequently than any other characteristic as the reason for a wetland being attractive. Apparently, they did not necessarily know and appreciate the diversity of all wetland species, but they did associate seeing birds with nature.

Supporting the hypothesis of cultural sustainability, perceptions of good care and a good place to enjoy nature strongly predicted attractiveness for both groups for these six metropolitan wetlands. However, these data suggest that perceived safety or seeing a place as good for children's play is related to attractiveness only for neighbors of wetland sites. Furthermore, all of the cultural perception variables are highly related for neighbors, but for visitors only a good place to enjoy nature and care are correlated significantly. Possibly, neighbors' familiarity with wetland sites leads them to develop to a more integrated sense of wetland values.

Responses by all four groups, including administrators and maintenance staff, to the open-ended questions about what made a place look attractive or unattractive suggest that weeds and litter, reflecting poor

Table 7. Stepwise linear regression of the cultural perception factor (included care, nature, safety, place for children), site variables, and species richness variables on perceived attractiveness by neighbors of wetland sites.

Model Predictors (with constant)	Adjusted R Square	Degrees of Freedom	Significance of F Change
All cultural variables factor	0.767	45	.000
Bird species richness	0.786	44	.032

Table 8. Stepwise linear regression of cultural perception variables, site variables, and species richness variables on perceived attractiveness by visitors to wetland sites.

Model Predictors (with constant)	Adjusted R Square	Degrees of Freedom 2	Significance of F Change
Care	0.211	80	.000
Place to enjoy nature	0.270	79	.008

care, were highly noticeable as unattractive. While some attractive wetlands were described as clean, neat, or mown, more often they were described as having noticeable wildlife, paths or structures, trees or woodlands, and open water. The open-ended responses underscore the fundamental importance of maintenance to prevent the impression of neglect. They suggest that ''just enough'' highly visible care may act as a threshold that allows more picturesque, apparently natural, characteristics to be recognized as attractive.

Site characteristics that were hypothesized to affect attractiveness (Table 1) were supported by these analyses. A study that sampled more than six wetland sites and analyzed these site characteristics as interval or ratio variables might have shown a stronger relationship with cultural perception variables in the linear regression models. However, these binomial variables did indicate significant differences. For neighbors, both cultural cues and natural landscape context were associated with significantly more positive perceptions of attractiveness as well as care, a place to enjoy nature, and safety. Visitors had similar reactions to wetlands in a natural landscape context, but there were almost no visitors to sites that lacked cultural cues. Study sites coded as having ''cues'' each had visible open water, as well as at least three of these cues: visible mown areas, apparent flowers, rolling terrain, and well-placed signs and structures. Content analysis of open-ended items suggested that the site design and structures contributed significantly to perceived attractiveness for all four groups. Even for the urban planted site, where the planting design was not yet completely apparent and the structures had not been completed during the period of survey, respondents appreciated the attractiveness of what they described as the wildflowers on the site.

CONCLUSIONS

While ecologically appropriate planting, adequate wetland hydrology, and weed management are essential to the sustainability of wetland restorations, our collaborative project in cultural and ecological monitoring suggests that cultural sustainability also is key to long-term restoration success. Design strategies that frame wetland restorations with the appearance of familiar cultural cues to landscape aesthetic value (like small, highly visible mown areas, bold planting patterns, and flowery planting mixes), that introduce structures for viewing open water to match cultural values without turning restored wetlands into tidy ponds, that use signs to help people appreciate the natural processes they are observing—all may help people appreciate the new forms of natural beauty offered by wetland restorations. Visitor and neighbor preferences for sites that included some highly visible mown areas is not a call for broad grassy lawns in place of wetlands or for mowing that extends to open water. Rather, they suggest that small mown areas near visitor entries or at neighborhood boundaries may establish an impression of care that will help to protect buffer strips and wet meadow zones from misplaced mowing. Within both sets of metropolitan sites, where structures and an overall site design were part of the planted wetland restoration, it was perceived as more attractive than the unplanted restoration. Restored wetlands that were designed to create a bold, noticeable pattern of flowering plants were perceived as more attractive than those that aimed to achieve enhanced ecological function only. As the wetland restoration sites mature beyond the first year, they are anticipated to have many prairie and wetland wildflowers. Possibly, their plant species richness and attractiveness may be more strongly related as these metropolitan wetlands are monitored in the future.

Context in a natural area clearly matters for human experience as well as biodiversity. However, birds and people are probably paying attention to different aspects of context. For people, larger size of a natural area and signs that indicate that these are protected natural areas are cues that help them appreciate the beauty of ecosystems that might otherwise seem unkempt in a metropolitan setting. For birds, inherent habitat qualities undoubtedly are more relevant.

Based on our first application of the cultural and ecological monitoring protocols in our larger project, my collaborators and I recommend the following strategies for cultural intervention in ongoing restorations and for designing future restorations to enhance possibilities for ecological success.

- Select and design the context of wetland restorations to support their ecological values and to be part of a contiguous experience of nature for visitors.

- Design restored wetlands to maximize habitat values. Songbirds and waterfowl will be particularly appreciated by visitors and neighbors.
- Plant restorations rather than relying only on altered hydrologic regime and natural recolonization—whenever resources allow.
- Design wetland restorations to provide cultural cues to familiar aesthetic values that can be constructed immediately (structures, signs, strategically placed areas of turf) to help viewers understand the stewardship intention and developing beauty of the wetland.
- Design wetland restoration plantings to be flowery and colorful, as well as to mimic native ecosystems.
- Where open water is part of the ecosystem appropriate to the site, design restorations to bring people near open water without fragmenting wetlands, and design extended views over water.
- Design wetland restorations to anticipate the need for maintenance over the long term, and program resources to provide for maintenance that is attuned to the particular characteristics of wetland restorations.

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