The impact of environmental education
on sense of place among urban youth

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Abstract. Research suggests that an ecologically informed sense of place, including strong place attachment and ecological place meaning, contributes to pro-environmental behaviors. Yet it is unclear whether an intervention such as environmental education can intentionally influence sense of place, especially in cities. To investigate the impact of urban environmental education programs on sense of place, we used pre/post surveys of youth in 5-week environmental and non-environmental summer youth programs in the Bronx, New York City, in 2010. Results show that urban environmental education programs—which engaged urban high school students in environmental stewardship, recreation, environmental skills development, and environmental monitoring in the Bronx—were successful in nurturing ecological place meaning, but did not strengthen students' place attachment. No significant changes in place attachment or place meaning were observed after non-environmental, control programs.

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INTRODUCTION

In a recent article about the Ecological Society of America's Earth Stewardship initiative to promote "the long-term integrity of the biosphere and human well-being," Chapin et al. (2011) suggest that sense of place fosters an individual's willingness to engage in environmental stewardship, including in cities. In fact, research shows that different aspects of sense of place contribute to pro-environmental behaviors or behavioral intentions (Stedman 2002, Walker and Chapman 2003, Ryan 2005, Halpenny 2010, Scannell and Gifford 2010). Keeping in mind this relationship, scholars propose that sense of place could be purposely influenced in order to promote pro-environmental behavior (Walker and Chapman 2003). However, little is known about whether sense of place can be modified through interventions such as education programs, especially in the urban context.

Given a call for environmental stewardship including in urban areas, and the relationship between sense of place and pro-environmental behavior, we wanted to explore whether sense of place can be nurtured by urban environmental education. This question is especially important given that half of the world's population lives in cities (UN-HABITAT 2008), characterized as "the dominant global human habitat" (Grove 2009) and "the defining ecological phenomenon of the twenty-first century" (Newman and Jennings 2008). We hypothesized that sense of place can be influenced by urban environmental education. Since natural elements are less dominant in cities relative to more rural settings (Barlett 2005a, Johnson and Catley 2009), a particularly provocative question is whether education programs

can help people view living organisms, biological processes and ecosystems as integral parts of the urban environment, i.e., as part of their sense of place.

Urban environmental education programs, in which inner-city students explore local natural phenomena or participate in stewardship, have existed in the Bronx for many years. In the early 1950s, students from kindergarten to the upper grades were using urban natural trails in the Bronx to learn about natural science (Polley et al. 1953), and over the last four decades school groups have taken part in environmental monitoring and wetlands restoration near the Bronx River (Tanner et al. 1992). More recently, students in public schools (de Kadt 2006), and in education programs in community-based organizations such as Rocking the Boat and Youth Ministries for Peace and Justice (Young 2008, de Kadt 2011), have engaged in learning about the Bronx environment through water testing, field trips, collaborating with researchers, restoration projects and related activities. Although urban environmental education programs have a long history, we are not aware of research showing that urban environmental education programs foster an ecologically informed sense of place.

In 2008, the first author conducted exploratory interviews of urban environmental educators in six community-based organizations in the Bronx, New York City. The educators claimed that their programs were reconnecting urban communities, including youth, with their urban natural environment in order to improve their pro-environmental behavior. Upon being introduced to the notion of sense of place, educators agreed that this "reconnecting" with the urban environment could be conceptualized as nurturing an ecologically based sense of place. Thus, the purpose of this study was to determine the impact of urban environmental education programs on youths' ecologically informed sense of place in the Bronx.

SENSE OF PLACE LITERATURE

The idea of sense of place has evolved during several decades and has been used in different fields. Leopold's (1949) suggestion that landscapes include multiple aspects such as ethical, esthetic, economic, and ecological resembles the current idea of multiple dimensions of place

meanings. Firey (1945) recognized that people ascribe symbols to places based on cultural values and historical associations, and these symbols may influence land use. Lynch (1960) was one of the first to use the term "sense of place," referring to symbolic and memorable aspects of the urban environment. In the 1970s, Tuan (1974, 1975, 1977) developed an experiential perspective on sense of place, which in his view is created through personal experiences with physical settings, and which can be understood through holistic studies of lived experiences. At the same time, Relph (1976) distinguished such aspects of sense of place as place attachment and place meaning. In his view, place attachment represents ties between people and places, and place meaning is the essence of places or symbolic associations of places that define people's individual and cultural identity. These earlier works inspired sense of place scholarship in different fields such as environmental psychology, human geography, cultural anthropology, architecture, sociology, and leisure studies (see a review by Farnum et al. 2005), as well as urban environmental restoration, stewardship, and conservation (Ryan 2000, Andersson et al. 2007, Spartz and Shaw 2011).

While there are multiple conceptualizations of sense of place, in this paper we define sense of place as a combination of place attachment and place meaning (Stedman 2000a, 2002, Stokowski 2002, Stedman 2003b, Farnum et al. 2005, Smaldone et al. 2005, Van Patten and Williams 2008, Trentelman 2009, Semken and Brandt 2010) (Fig. 1). "Place attachment" is the bond between people and places (Low and Altman 1992, Jorgensen and Stedman 2001, Stedman 2003a, Davenport and Anderson 2005). Conceptually, place attachment includes place dependence, i.e., the potential of a place to support preferred activities (Stokols and Shumaker 1981, Vaske and Kobrin 2001, Farnum et al. 2005, Halpenny 2006), and place identity, i.e., the extent to which a place reflects personal identity (Proshansky et al. 1983, Korpela 1989, Trentelman 2009). "Place meaning" refers to the symbolic meanings that people ascribe to places (Stedman 2000b, 2002, 2008, Smaldone et al. 2008), which may reflect the physical, natural, social, cultural, familial, political, economic or other aspects of places (Ardoin 2006, Semken and Butler Freeman 2008). In sum,
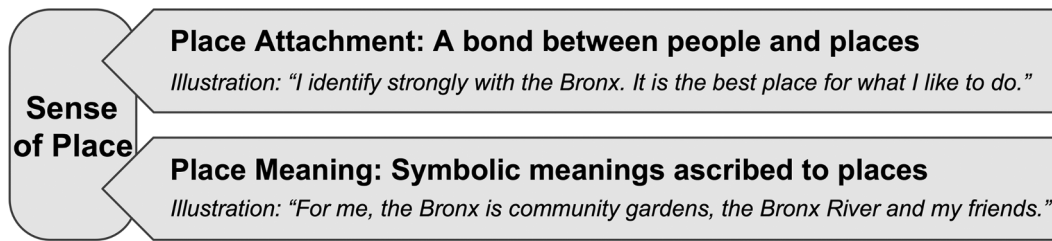
Fig. 1. Components of sense of place (adapted from Kudryavtsev et al. 2012).

place attachment reflects how strongly people gravitate towards places, while place meaning describes the reason for place attachment (Stedman 2008).

In recent years researchers accumulated empirical evidence that sense of place—including place attachment and the ecological dimension of place meanings—may contribute to place-specific pro-environmental behaviors, behavioral intentions, and attitudes. For example, correlational studies showed that people with strong place attachment are likely to contribute to solutions of local environmental problems (Kaltenborn 1998), support bans on motorized recreation in natural areas (Warzecha and Lime 2001), hold negative attitudes towards hydropower development (Vorkinn and Riese 2001), express an intention to maintain valued natural resources such as water quality in lakes (Stedman 2002), volunteer in parks (Walker and Chapman 2003), and be concerned about conserving nature in cities (Ryan 2005). Similarly, several studies using structural equation modeling showed that place attachment predicts place-specific pro-environmental behavior such as volunteering to protect parks (Halpenny 2010), civic actions such as donation of time and effort in nature refuges (Payton et al. 2005), general pro-environmental behavior not related to a specific place such as supporting environmental organizations and carpooling (Lee 2011), and other types of behavior such as participating in a community cleanup (Vaske and Kobrin 2001).

Other studies suggest that pro-environmental attitudes and behavior are fostered by strong place attachment *in combination* with emphasized ecological place meaning. Advancing our understanding of the interaction between attachment and meanings, Brehm et al. (2006) found that attachment that is based on such place meanings as "natural landscapes" and "presence of wild-

life" contributes to supporting environmental protection policies. Similarly, Scannell and Gifford (2010) found that place attachment based on the natural rather than the civic aspects of a place predicted pro-environmental behavior, and Henwood and Pidgeon (2001) showed that people express concerns about potential urbanization if their place meanings include such symbols as trees and forest. Supporting this idea, Andersson at al. (2007) revealed that strong place attachment along with place meanings related to ecological knowledge and practice were drivers for stewardship in allotment gardens. Finally, researchers contend that people tend to protect places (Manzo and Perkins 2006) or aspects of places (Stedman 2003b) that are meaningful to them, which is consistent with the idea that emphasized ecological place meanings may contribute to pro-environmental behavior.

Factors influencing sense of place have been reasonably well explored and can be organized in two groups: direct experience of settings, and learning about places from other people or interpretive materials. A number of empirical studies demonstrate that place attachment is strengthened by frequent visits and use of places (Ryan 2005), commitment to outdoor recreation activities that happen in a particular place (Moore and Scott 2003), long-term residence (Lewicka 2005), and active engagement with places such as participating in hands-on environmental stewardship activities (Ryan et al. 2001). Place attachment can also be strengthened through social interactions in places and opportunities to be a functional community member (Chawla 1992, Eisenhauer et al. 2000, Barlett 2005b, Ryan and Grese 2005). Place meanings are somewhat more difficult to trace causally (Stedman 2002) but can be informed by direct experiences with places, including by character-

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Box 1

Place attachment and ecological place meaning Likert scales (5-points: "Strongly disagree," "Somewhat disagree," "Neutral," "Somewhat agree," and "Strongly agree").

Place Attachment Scale
1. The Bronx is the best place for what I like to do.
2. I feel like the Bronx is part of me.
3. Everything about the Bronx reflects who I am.
4. I am more satisfied in the Bronx than in other places.
5. I identify myself strongly with the Bronx.
6. The Bronx is not a good place for what I enjoy doing. (reverse coded)
7. There are better places to be than the Bronx. (reverse coded)
8. The Bronx reflects the type of person I am.

Ecological Place Meaning Scale
1. The Bronx is a place to connect with nature.
2. The Bronx is a place to watch animals and birds.
3. The Bronx is a place where people can find nature.
4. The Bronx is a place where trees are an important part of community.
5. The Bronx is a place where people have access to rivers.
6. The Bronx is a place where people come to community gardens.
7. The Bronx is a place where people have access to parks.
8. The Bronx is a place to canoe and boat.
9. The Bronx is a place to have fun in nature.
10. The Bronx is a place to learn about nature.
11. The Bronx is a place to enjoy nature's beauty.
12. The Bronx is a place to grow food.

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istics of the biophysical environment (Stedman 2003a, Manzo 2005), as well as by information about a place from other sources (Johnson and Zipperer 2007). Traveling outside of a place may help people accentuate its meanings, which may be taken for granted (Davenport and Anderson 2005, Smaldone et al. 2008), and sometimes people may realize that they were attached to a place after it has been changed (Ryan 2000). Scholars also suggest that place meanings can be conveyed, nurtured or created through interpretative materials, mass media, literature, films, photography, legends, customs, discussions, storytelling, and other social interactions (Stewart et al. 1998, Stokowski 2002, Vanclay 2008, Malpas 2010).

RESEARCH QUESTION AND METHODS

Given the link between sense of place and pro-environmental behavior, and given educators'
goal to nurture sense of place in urban youth, this research explores the impact of urban environmental education on two components of sense of place. Specifically, we ask: (1) What is the effect of urban environmental education on youth's place attachment? (2) What is the effect of urban environmental education on youth's ecological place meaning?

To answer these questions, we conducted a survey study in environmental and non-environmental summer youth programs in the Bronx, New York City. First, we developed and pilot tested a sense of place survey with youth in urban settings in the Bronx. Then we used a quasi-experimental research design to implement pre/post-program sense of place surveys with Bronx youth in an experimental group (urban environmental education programs) and a control group (non-environmental summer youth employment programs). Pre/post-program survey results from both groups were compared by

two-tailed *t*-tests, using Stata 10 software. We also used Pearson's correlation to explore whether place attachment becomes more based on ecological place meanings after urban environmental education programs.

SURVEY DEVELOPMENT

To explore the impact of urban environmental education on Bronx students' sense of place, we adapted an existing place attachment scale (Jorgensen and Stedman 2001) and created a new ecological place meaning scale appropriate for the urban context (Box 1).

Place attachment scale

To assess place attachment, scholars often use Likert scale surveys with items such as "This is the best place for what I like to do" and "I feel like this place is part of me" (Williams and Roggenbuck 1989, Stedman 2000a, Jorgensen and Stedman 2001, Warzecha and Lime 2001, Kyle et al. 2004). In all of the studies that we are aware of, place attachment scales are reliable (Cronbach's alpha > 0.7), whether place attachment is measured as one scale (Moore and Scott 2003, Stedman et al. 2007) or two separate scales for place dependence and place identity (Vaske and Kobrin 2001, Williams and Vaske 2003, Burduk et al. 2009).

To measure place attachment, we used a five-point Likert scale with items representing two sub-constructs: place identity and place dependence. We adapted these items from Jorgensen and Stedman's (2001) scale, a reliable scale used in previous research projects (e.g., Stedman et al. 2007, Halpenny 2010). Although other place attachment scales have been adapted for youth (Vaske and Kobrin 2001, Rioux 2011), we decided not to use them because some of their items are not completely consistent with our underlying theoretical constructs. For example, Vaske and Kobrin's (2001) items "I am very attached to this place" and "I think often about coming here" are supposed to reflect place identity; yet we contend that these items probably reflect place attachment overall, not specifically place identity. To ensure that our place attachment scale could be understood and used with urban high school students, in January 2010 we conducted a pilot test of this scale, along with the ecological place meaning

scale described below. We administered the scale to ten high school students (approximately 15 years old) in the Bronx participating in summer youth employment programs that were not related to the environment. After completing the paper-based survey the students discussed how their understanding of the questions, which led to minor revisions of items to make them more understandable.

Ecological place meaning scale

We are not the first to employ a quantitative approach to explore place meaning. For example, in relation to a national park, Young (1999a, b) used a five-point scale to rate how well a place can be described by 26 place meaning items such as "ecologically important," "scenic," and "spiritually valuable." In addition, Stedman (2002, 2003b) and Stedman et al. (2007) used Likert-scale surveys in a rural county to assess meanings related to environmental quality ("My lake is a place of high environmental quality"), meanings related to social aspects of places ("My lake is a place to escape from civilization"), and ecological place meanings appropriate for rural areas ("My lake is a pristine wilderness"). Although researchers have called for the development of a scale to measure an ecological dimension of the relationship between people and places (Davenport and Anderson 2005), we are not aware of ecological place meaning scales per se, especially those applicable to the urban environment.

To measure ecological place meaning in the Bronx, we constructed a five-point Likert scale with 12 items. These items share a common underlying construct: viewing nature-related phenomena, including ecosystems and associated activities, as symbols of the Bronx. To create scale items, we asked environmental educators in six community-based organizations in the Bronx to list phenomena (e.g., birds and parks) and activities (e.g., gardening and canoeing) that may serve as ecological place meanings in the Bronx. Based on conversations with the educators we created an ecological place meaning scale that initially included 17 items. This scale was refined through pilot testing with the ten above-mentioned high school students to make the items understandable for this age group. The final ecological place meaning scale was reduced to 12

items to avoid redundancy. We decided to word all items positively in the ecological place meaning scale because we were focusing on meanings that have a positive valence. Further, we did not want to unnecessarily burden or confuse our youthful respondents by including negative non-ecological place meanings or re-wording some items as negative (e.g., "The Bronx is not a place to get close to nature") (DeVellis 2003).

Content validity of the ecological place meaning scale, i.e., how appropriate the items are to measure a construct (Haynes et al. 1995, Litwin 1995, DeVellis 2003), is based primarily on the expertise of the Bronx environmental educators who helped us create scale items reflecting nature-related settings and activities appropriate for the local context. Content validity can be compromised by exclusion or under-representation of items reflecting different dimensions of a construct (Haynes et al. 1995); thus we decided to include a relatively large number of scale items that are representative of and relevant to the Bronx natural environment. Construct validity, which is "the extent to which a particular measure relates to other measures consistent with theoretically derived hypotheses concerning the concept" (Carmines and Zeller 1979) or "how meaningful the scale or survey instrument is when in practical use" (Litwin 1995), can be tested through experimentation in which two groups are expected to differ on the test (Cronbach and Meehl 1955). In our case, as we describe in the results section below, construct validity is confirmed by the fact that ecological place meaning became more emphasized among students in urban environmental education, and not among students in the non-environmental programs.

Survey Implementation

To explore the impact of urban environmental education programs on sense of place in youth we used a quasi-experimental research design, which involves experimental and control groups where true randomization is not possible (Anderson 1990, Shadish and Cook 2002, Wiersma and Jurs 2005). We administered pre/post-program surveys to youths in urban environmental education (experimental group) and non-environmental summer youth employment programs (control group) located along the Bronx River watershed in New York City (Table 1). In July-August 2010, experimental and control students participated in 5–6-week summer youth programs in community-based organizations and at a high school, usually Monday through Friday, about 24 hours per week. Students in both groups earned minimum wage, except for 16 students within the experimental group who earned high school credit toward graduation.

Programs in the experimental group can be broadly categorized as urban environmental education. This is the term preferred by educators in these programs. Although a number of studies have focused on environmental education in cities (Krasny and Tidball 2009, Tidball and Krasny 2010), a comprehensive literature and theoretical framework for urban environmental education is lacking. Urban environmental education programs involve urban youth in restoration, stewardship, monitoring, recreation and activism with the ultimate goal to improve ecological and social aspects of the urban environment. A shared goal in most urban environmental education in the Bronx is reconnecting urban communities with the urban environment. In addition, these programs pursue

Table 1. High school students in experimental and control groups.

Group	Group description	Age	Sex
Experimental (n = 63)	Students in 5–6-week summer urban environmental education programs in three community-based organizations and one high school: Satellite Academy High School in the Bronx (16 students), Rocking the Boat (12), Mosholu Preservation Corporation (20), and Youth Ministries for Peace and Justice (15).	Mean age = 16.2 Min age = 14 Max age = 21 SD = 0.23	♂ = 36 (57%) ♀ = 27 (43%)
Control (n = 24)	Students of similar characteristics in 5–6-week non-environmental summer youth employment programs in two community-based organizations: Phipps Community Development Corporation (14 students) and the Point Community Development Corporation (10).	Mean age = 16.3 Min age = 14 Max age = 20 SD = 0.39	♂ = 13 (54%) ♀ = 11 (46%)

other goals such as youth development, which we did not evaluate.

Organizations in our study regularly conduct several-week urban environmental education programs in spring, summer and fall semesters. We administered surveys in summer when a relatively large number of new students join these programs, which allows conducting a quasi-experimental study with a reasonable sample size. Our sample included youth participants at all available urban environmental education programs whose curriculum focused on the environment along the Bronx River watershed in the Bronx, New York City in summer 2010. The content of urban environmental education programs in our study varied. Instead of using or adapting existing curricula such as Project Learning Tree or Project WET, educators designed their own activities. Four activities dominated each program: (1) environmental stewardship, (2) recreation, (3) environmental monitoring, and (4) trainings and workshops (Fig. 2).

Environmental stewardship activities in the experimental group were embedded in civic ecology practices (Tidball and Krasny 2010; Krasny and Tidball, *in press*), e.g., working alongside environmental leaders or community members to steward street trees, restore oyster reefs, water plants in community gardens, remove invasive plants in an urban forest, reintroduce fish in the Bronx River, or maintain a green roof. Recreation activities included canoeing, kayaking, or rowing on the Bronx River or other waterways. Environmental monitoring activities took place in parks, botanical and community gardens, or along waterways, and included creel surveys, bird surveys, or water quality testing. Trainings and workshops led by invited community leaders, professional ecologists, and staff from local colleges included indoor and outdoor sessions focused on learning about environmental science and developing environmental skills such as tree pruning and plant identification. In addition, each program in the experimental group included several unique activities such as a food survey at farmers markets and stores; a trip to a farm, island or historic area outside the Bronx; or watching a movie related to environmental justice. The shared focus on the urban environment and overlapping educational approaches justify categorizing these environmental programs as one experimental group, despite some differences in actual activities. In contrast, students in the control group participated in office work and mentoring younger students in summer programs, while engaging in activities related to mixed media, arts, dance, and sports, which took place mostly indoors. Most students in both the experimental and control groups also participated in team building activities and college visits.

On the first day of the programs, students completed the pre-program, paper-based survey at home because parental permission was required for students under 18 years old. Students who took the pre-program survey also participated in the post-program survey on the last day of their programs at the sites where their programs were held, and received $5 in compensation. In the experimental group, 63 students completed both pre/post-program surveys (80% return rate); and in the control group, 24 students completed both surveys (60% return rate). Differences between experimental and control groups (Table 1) in terms of participants' mean age ($t(85) = 0.25$, $p = 0.80$) and sex ratio ($Chi2(1, N = 87) = 0.06$, $p = 0.80$) are not significant. Most students in the experimental group (86%) and control group (92%) live in the Bronx, while a few students live in other boroughs of New York City. According to educators, except for 2–3 returning students in the experimental and control groups, students were participating in these programs for the first time and had limited prior knowledge about the programs. Participants' ethnicity was not recorded, but we observed that both experimental and control groups were comprised of approximately equal numbers of African Americans and Latinos.

RESULTS

Place attachment mean scores in pre/post-program surveys in the experimental and control groups ranged from 2.77 to 3.02, which is about the midpoint on the 5-point scale (Table 2). Ecological place meaning scores in the same surveys were slightly above the midpoint (Table 3), with the exception of the post-program experimental group, which scored higher (3.57). The pre-program unpaired *t*-test demonstrated

Fig. 2. Examples of urban environmental education activities in the Bronx, New York City, summer 2010: (A) Environmental stewardship on a green roof, Youth Ministries for Peace and Justice, (B) Recreation on the Bronx River, Rocking the Boat, (C) Biodiversity monitoring by students from Satellite Academy High School, (D) Tree pruning workshop conducted by Trees New York for students at Mosholu Preservation Corporation. Photos: Alex Kudryavtsev.

Table 2. Place attachment survey results.

Group	n	Pre-program			Post-program			Paired t-test		
		Mean	SD	Alpha	Mean	SD	Alpha	t	df	p
Experimental	63	2.90	0.88	0.85	3.02	0.83	0.84	1.378	62	0.173
Control	24	2.85	0.94	0.90	2.77	0.91	0.86	0.532	23	0.600

Table 3. Ecological place meaning survey results.

Group	n	Pre-program			Post-program			Paired t-test		
		Mean	SD	Alpha	Mean	SD	Alpha	t	df	p
Experimental	63	3.16	0.91	0.93	3.57	0.85	0.92	4.777	62	0.000
Control	24	3.04	0.88	0.91	3.05	0.93	0.94	0.048	23	0.962

no significant difference between the experimental and control groups in terms of their initial place attachment ($t(85) = 0.239$, $p = 0.812$) or their initial ecological place meaning ($t(85) = 0.557$, $p = 0.579$), which suggests that the likelihood of initial selection biases is small.

Using paired t-tests to compare pre/post-program mean scores, we found that place attachment showed no significant change in either group (Table 2). At the same time, we found that the mean score for ecological place meaning increased significantly in the experimental group from 3.16 to 3.57, and did not change in the control group (Table 3). For the experimental group, Pearson's correlation between place attachment and ecological place meaning was not significant in pre-program ($r(61) = 0.177$, $p = 0.166$), but became significant post-program ($r(61) = 0.358$, $p = 0.004$). In the control group, this correlation was significant in pre-program ($r(22) = 0.416$, $p = 0.043$) and post-program ($r(22) = 0.728$, $p = 0.000$).

Discussion

As the global population becomes increasingly urban (Bloom 2011), attention needs to be paid to how humans can foster sustainability and provide for ecosystem services in cities (Andersson 2006). In particular, scholars have called for enhancing environmental stewardship and related environmental education in cities (Tidball and Krasny 2007, Krasny and Tidball 2009), and suggest that sense of place may facilitate stewardship for ecosystem resilience and human well-being (Chapin et al. 2011). Our research shows

that, to a certain extent, interventions such as urban environmental education may nurture sense of place, which others have found might foster place-specific pro-environmental behaviors.

The survey results in the experimental group suggest that relatively short yet intensive summer urban environmental education programs may significantly increase students' ecological place meaning, i.e., their perceptions of the presence and importance of nature in the local urban setting. Because improvement was not observed in the control group engaged in non-environmental programs, strengthening ecological place meaning in the experimental group may be attributed to these urban environmental education programs that combine multiple teaching approaches. Our finding is consistent with the idea that place meanings are not solely inherent (Greider and Garkovich 1994) and may be influenced through direct experiences and interpretations of places (Cuba and Hummon 1993). Indeed, ecological processes in urban places can become part of sense of place through participation in the environmental restoration activities (Newman and Jennings 2008) that were a significant component of the urban environmental education programs in this study. However, based on our survey data, we are unable to determine the effect of specific aspects of urban environmental education programs on ecological place meaning. For example, recreation in natural areas and environmental monitoring activities may have a different effect on ecological place meaning.

The pre-program mean scores of ecological

place meaning in the experimental and control groups were just above the midpoint on a 5-point scale, and thus cannot be considered particularly high scores. Our explanation of these scores is based on ideas that place meanings are rooted in characteristics of the physical environment (Stedman 2003a), which is far from pristine in cities, and social and interpretive mechanisms through which place meanings are developed, negotiated and shared (Stewart et al. 1998, Stokowski 2002). Urban environmental educators suggested several reasons for moderate pre-program ecological place meaning scores, including students' generally limited experience of natural aspects of the Bronx before urban environmental education programs (C. Kennedy, *personal communication*). Some of these students rarely experienced the natural environment in the inner city because of highways, industrial facilities, or other infrastructure blocking access to waterfronts or other green areas in their communities (J. Terrell, *personal communication*). In addition, some parents in the Bronx discourage their children from involvement with the urban natural environment including community gardens because of its perceived lack of safety (J. Plewka, *personal communication*). Finally, ecological place meaning in the Bronx is perhaps sometimes underemphasized due to stigmatization of this area as ecologically degraded, akin to other types of stigmatization of inner-city places (Wacquant 2007). Similar to what researchers have reported in relation to inner-city, high density neighborhoods in general (Permentier et al. 2011), residents of the Bronx may think that the Bronx has a poor reputation compared to "low-density garden-city neighborhoods," and thus assign little ecological meaning to this place.

Contrary to place meaning, urban environmental education programs in the Bronx did not significantly strengthen place attachment. This result may be explained by research that suggests that place attachment develops over long or frequent experiences of places (Tuan 1977, Hay 1998). The environmental education programs in this study were only 5–6 weeks long, which is perhaps not enough time to increase attachment to a place where most participants already reside. Sometimes people do not bond with a place even if they grew up there (Johnson and Zipperer 2007), which may be another explanation of

Bronx students' weak place attachment. It is also possible that, similar to environmental stewardship activities in other studies (Ryan et al. 2001, Ryan 2005), urban environmental education with a focus on environmental stewardship is more likely to foster general place attachment to certain types of ecosystems, such as rivers and parks, than attachment to a particular place.

Whereas we measured place attachment only to the Bronx, one could hypothesize that urban environmental education may be more successful in strengthening place attachment towards specific places where education activities are conducted, such as a certain park, section of a river, or particular community garden. Further, our findings contrast with another study in the nonurban context (Semken and Butler Freeman 2008), in which undergraduate students' place attachment towards Arizona significantly strengthened as the result of taking an introductory geology course. We may hypothesize that pedagogical approaches, curriculum, audience demographics, location and length of residence, the scale and characteristics of places, and other factors determine the effect of different types of education programs on place attachment and sense of place in general. Factors influencing sense of place in the urban stewardship context could be addressed in future quantitative studies with a larger sample size or in-depth qualitative studies. In fact, currently we are conducting narrative research with educators and youth in these same Bronx organizations to explore the mechanisms of nurturing sense of place among urban students.

The mean pre/post-program place attachment scores in the Bronx in both experimental and control groups are around the midpoint or lower on the 5-point scale. In contrast, place attachment in other studies conducted in more natural areas such as trails, parks and lakes was considerably above the midpoint (Moore and Scott 2003, Stedman et al. 2007). Based solely on our research we cannot claim that attachment to a city is in general lower than attachment to more rural or natural places. Yet relatively low place attachment in the Bronx could be explained by the fact that many students in the Bronx hold both positive as well as strong negative place meanings underpinning their place attachment. For example, in informal conversations with the

first author, some students mentioned such positive descriptors of the Bronx as family, friends, and home, as well as negative descriptors such as crime, poverty, underserved schools, industrial facilities, highways, empty lots, dirty streets, air pollution and lack of parks.

While place attachment may be based on different place meanings (Stedman 2003b), including social and natural (Brehm et al. 2004, Brehm 2007), a notable result of this study is that the correlation between place attachment and ecological place meaning in the experimental group became significant after treatment. This suggests that, although place attachment in the experimental group did not increase, it became more based on an ecological set of place meanings. This also corresponds to Barlett's (2005a) idea that attachment to urban places can be based on meanings of place related to such natural components as trees, grass and birds. However, an unexpected result was that in the control group this correlation was significant in both pre-program and post-program survey, which may suggest that there were some unobserved differences between control and experimental groups that are not easily interpretable.

Applying the concept of ecological place meaning to urban settings is quite provocative because usually the built environment rather than the natural environment dominates our attention in cities (Barlett 2005a, Budruk et al. 2009), and because natural aspects are sometimes perceived as occurring only outside the city (Johnson and Catley 2009). One of the motivations for this research was that acknowledging the presence of green areas in cities and of the ecological worthiness of urban places—which reflects positive place meanings—might inspire commitment to urban environmental stewardship (Light 2003, Ryan 2005). In contrast, exclusively negative environmental information, which is sometimes emphasized in environmental education, media, and other descriptions of cities, may lead to the denial of environmental problems (Dickinson 2009) or the feeling that one cannot contribute to environmental solutions (Ewing and Gold 2011). Thus urban environmental education programs that emphasize ecological place meaning or worthiness of the natural environment in cities may inspire com-

munity-based initiatives to create more urban farms, roof gardens, community gardens and greenways, or to further restore aquatic ecosystems and urban forests. Similar to other feedback loops in social-ecological systems (Tidball and Krasny 2011), it is possible that ecological place meanings and community-based environmental stewardship may be reinforcing each other, especially if education programs are embedded in environmental stewardship.

Finally, developing ecological place meaning could redefine self-identity of urban residents, which, given the link between self-identity and pro-environmental behavior (Devine-Wright and Clayton 2010, Whitmarsh and O'Neill 2010), may influence how people interact with their environment. Sense of place in general "is understood as closely linked to identity" (McClaren 2009) and our place meanings are related to our sense of self and may tell who we are (Korpela 1989, Hull et al. 1994). In addition, meanings that people attribute to their environment are viewed as "symbolic reflections of how people define themselves" (Greider and Garkovich 1994). Hence it is possible to assume that place meanings like "The Bronx is a place to connect with nature" may foster such self-conceptions as "I am a person who connects with nature in the Bronx," thus contributing to nature conservation attitudes and environmental stewardship in the urban context.

CONCLUSION

Resonating with Chapin and colleagues' (2011) call for Earth Stewardship, previous research has demonstrated that place-based stewardship behaviors may be facilitated by sense of place. Our research further shows that sense of place in cities can be nurtured by urban environmental education. Urban environmental education programs in the Bronx help young people see ecological aspects of the urban landscape as legitimate and worthwhile. These programs teach students to view cities as places to interact with nature, grow food, and engage in outdoor recreation and learning. Such sense of place may ultimately enhance environmental stewardship in urban communities. The concept of ecological place meaning—combined with other constructs such as place attachment, self-identity, pro-

environmental behavior, and community-based restoration—may open new avenues for thinking about how people interact with urban natural resources and what motivates them to engage in environmental stewardship in cities.

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