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Educational initiatives

Natural area stewardship as part of campus sustainability

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ABSTRACT

Despite a growing body of evidence that spending time in nature through leisure, stewardship, and related activities is critical to the healthy development of humans and can lead to pro-environmental behaviors, higher education sustainability initiatives pay scant attention to the human–nature relationship. This relationship can be explored through constructs such as sense of place, as well as scales such as nature relatedness. Based on a literature review and interviews with members of a student organization focused on voluntary stewardship of campus open space and natural areas, we argue for a greater emphasis on student involvement in nature-based activities in university sustainability efforts. In particular, our exploratory study of a university student organization reveals that nature-based stewardship not only provides direct benefits to the campus environment (e.g., through tree planting), but also can enhance students' sense of place and play a role in students' mental well-being. Further, the literature and our results suggest that whereas sense of place and related well-being may foster conservation behaviors, the relationship between stewardship and unrelated environmental behaviors is less clear. Nature-based stewardship provides a complement to other aspects of sustainability, such as those focused on reducing consumption and energy use, and supports a holistic approach to university sustainability initiatives.

1. Introduction

Prior to the launch of the Decade of Education for Sustainable Development, Wals and Jickling (2002) warned about instrumental and prescriptive approaches in university sustainability initiatives, and about excluding issues of society–nature relationships and the intrinsic value of species. Now at the close of the Decade, Wals (2014) has found that higher education institutions are beginning to move towards systemic change by reorienting not only their operations, but also their approach to educating students to encompass trans- and interdisciplinary learning, social learning, project-based learning, and experiential approaches including those involving community outreach (Peters and Wals, 2013). While these transitions are promising, a review of university sustainability policy documents suggests that a more reductionist and mechanistic paradigm nonetheless prevails and higher education trails the private sector when it comes to transforming mindsets and practice (Lozano et al., 2013).

Consistent with a mechanistic and reductionist approach, university sustainability policy documents and rating systems have paid little attention to students developing a relationship with nature. This is despite a growing body of evidence that time spent in nature is critical to the healthy development of humans (Louv, 2006) and can be a strong predictor of environmental attitudes and behaviors (Nisbet et al., 2009; Wells and Lekies, 2006). By helping foster student well-being, time spent in and stewarding nature can support rather than detract from student engagement in important campus sustainability initiatives such as greenhouse gas reduction and reducing consumption.

An exception to much of the writing about sustainability in higher education is that of Jones (2013), who presents a case for the 'Biophilic University' that 'restores an emotional affinity with the natural environment' (p. 148). In creating his argument, Jones draws from sustainability scholar Lozano who argues for frame shifts in higher education that offer more holistic alternatives to reductionist and mechanistic cognitive maps of sustainability driven by assessment and reporting (Lozano, 2006a; Lozano et al., 2013); from Thomashow's (2010) work on inclusion of wellness and aesthetic principles in campus sustainability initiatives; and importantly from the work of E. O. Wilson and Stephen Kellert on biophilia (Kellert and Wilson, 1993; Wilson, 1984). Central to Jones' (2013) thesis is that through framing environmental concerns in

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emotional and aesthetic terms, the Biophilic University as an organizational metaphor has the potential to break down existing paradigms, and to foster a more integrative notion of campus sustainability encompassing ecological consciousness, contemplative spaces, and reflexive dialogue across the sciences, humanities, and other disciplines.

One potential strategy towards realizing a Biophilic University and the benefits of nature connectedness is engaging students in hands-on environmental stewardship on university campuses. Drawing from the writings of Leopold (1949), we define stewardship as physical work by a group of people to restore and maintain open space and natural areas. Stewardship of urban green spaces has been shown to foster a connection to natural areas or sense of place (Andersson et al., 2007; Austin and Kaplan, 2003; Ryan and Grese, 2005). Along with other measures of human–nature relationships such as nature relatedness (Nisbet et al., 2009; Zelenski and Nisbet, 2012), sense of place in turn has been shown to predict pro-environmental behaviors (Kudryavtsev et al., 2011; Stedman, 2002; Vaske and Kobrin, 2001) and has been linked to human health and well-being (Sampson and Gifford, 2010; Williams and Patterson, 2008). Concern with student well-being and instilling pro-environmental behaviors are important components of Jones' (2013) holistic approach to university sustainability. Further, student participation in stewardship provides opportunities for integrating sustainability into the educational and scholarly activities of the university (cf. Müller-Christ et al., 2014; Togo and Lotz-Sisitka, 2009).

The purpose of this paper is to make the argument for more substantive and formal integration of student engagement in campus open space and natural area stewardship into university sustainability initiatives. In making our case, we first draw from three bodies of literature that document the outcomes of hands-on environmental stewardship including: (1) a significant accumulation of research demonstrating the health and well-being benefits of exposure to, spending time in, and stewardship of nature; (2) studies of sense of place as an outcome of stewardship and a predictor of human well-being and pro-environmental behaviors; and (3) research indicating that positive experiences related to the environment and nature foster pro-environmental behaviors. We also present an overview of how open space and natural area management is treated in widely-used protocols guiding higher education sustainability initiatives.

Following the literature review, we report on the sense of place and environmental behavior outcomes of an exploratory study of a campus student organization that engages in natural resources stewardship and recreational hiking on a university campus and in nearby natural areas. In particular we asked: How do students describe sense of place and environmental learning and behavior outcomes of their involvement in a student organization devoted to hands-on natural resources stewardship, outdoor recreation, and engagement in campus natural area policy? Although we were predominantly interested in stewardship, we include recreational activities in our study as they also entail time spent in nature and may be an important motivator for student engagement in campus stewardship organizations.

2. Toward a more holistic approach: nature connectedness and sense of place

An environmental virtue ethics (Cafaro, 2001), which draws from the accounts of Henry David Thoreau, Aldo Leopold, and Rachel Carson describing humans living well in nature, provides a foundation for understanding the importance of nature connectivity as part of the university student experience. Such an ethic moves beyond a focus exclusively on rights, responsibilities, and upholding moral duty to incorporate nature preservation as part of 'enlightened self-interest' that enables humans to fulfill their potential. Personal development and enriched experience through the pursuit of knowledge of self and nature, such as lived by Thoreau at Walden, and embodied work to restore nature as described by Leopold, are means for ethical, intellectual, and creative striving (Cafaro, 2001). An environmental virtue ethics is consistent with calls for including not just the cognitive but also psychomotor and affective components in Education for Sustainable Development in higher education (Shrivastava, 2010; Sipos et al., 2008).

Moving from ethical underpinnings to empirical studies, a large body of research documents the benefits of human–nature contact for physical and emotional health, cognitive functioning, and community well-being, whereas a smaller number of studies points to additional outcomes of active stewardship. For example, studies have shown that the ability to see and actively experience plants and green spaces can quicken healing times (Ulrich, 1984), reduce stress (Okvat and Zautra, 2014; Park et al., 2010), improve cognitive functioning (Faber Taylor et al., 2001; Wells, 2000) and psychological health (Hartig et al., 1991; Kaplan and Kaplan, 1989), and in cities, is associated with stronger social ties (Kuo et al., 1998), sense of safety, and reduced crime (Branas et al., 2011; Kuo and Sullivan, 2001). To explain these and similar findings, Kaplan and Kaplan (2001) proposed the Reasonable Person Model, which suggests that people are more healthy psychologically, and thus more reasonable, if they have opportunities to explore new environments and learn new information, act in meaningful ways (e.g., volunteer to help others), and experience the restorative value of nature.

Supporting these notions, research has shown that compared to watching a video, walking in a natural setting for just 15 min increases attentional capacity, positive emotions, ability to reflect on a life problem, and connectedness to nature, which in turn predicts ecological behavior (Mayer and Frantz, 2004; Mayer et al., 2008). Other studies have demonstrated that college students who score higher on the nature relatedness scale, which integrates constructs from biophilia, ecological identity, and environmental knowledge, spend more time in nature, experience greater happiness, and display more environmentally sustainable attitudes and behaviors (Nisbet and Zelenski, 2011; Nisbet et al., 2009; Zelenski and Nisbet, 2012). According to Nisbet and Zelenski (2011), their work suggests 'a happy path to sustainability. Rather than (or in addition to) motivating people to behave in ways that are ecologically sustainable through obligation, fear, guilt, or economic incentives, policymakers might encourage contact with nature … In addition, the positive moods associated with experiences in nature could potentially motivate people to participate in more outdoor activities' (p. 1104).

Actively stewarding nature through such activities as urban prairie restoration and tree planting has additional outcomes for humans, including a sense of satisfaction from engaging in meaningful action (Miles et al., 1998) and a sense of pride and of competence that lead to further participation in neighborhood improvement (Austin and Kaplan, 2003; Kaplan and Kaplan, 2005). Further, Tidball et al. (2010) have shown how tree planting, community gardening, and other civic ecology practices are part of the recovery process for survivors of Hurricane Katrina in New Orleans and after other disasters (Tidball and Krasny, 2014). Environmental psychologists Okvat and Zautra (2014) proposed the Dynamic Model of Affect to explain how active nature stewardship such as community gardening helps individuals recover from stressful situations by inducing positive emotions, whereas Tidball (2012) links such resilience to an 'urgent biophilia' (Tidball, 2012). Other literature suggests additional outcomes of stewardship, including

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science and civic learning (Bouillion and Gomez, 2001; Fusco, 2001; Krasny and Tidball, 2009) and leaving a positive legacy for the next generation (Warburton and Gooch, 2007).

Sense of place is another outcome of spending time in and stewarding nature. Sense of place is defined as a combination of place attachment, that is the bond between people and places or the degree to which a place is important to people, and place meaning, that is the symbolic meanings that people ascribe to settings. Place attachment may be further broken down into place dependence, or the potential of a place to satisfy an individual's needs by providing settings for his or her preferred activities, and place identity, i.e., the extent to which a place becomes part of personal identity or embodied in the definition of self (Farnum et al., 2005; Stedman, 2002, 2003). Tidball (2014) and others (Gooch, 2003; Pred, 1983) have shown that symbolic and emotional meanings and memories developed through active experiences and participation in stewardship are important in developing sense of place. Studies of volunteer efforts in cities similarly have shown that hands-on natural area stewardship may lead to a sense of attachment to the neighborhood or ecosystem (Austin and Kaplan, 2003; Ryan and Grese, 2005), and Andersson et al. (2007) attributed a greater place attachment among allotment gardeners in Stockholm relative to managers of cemeteries and city parks to the more active participation of allotment gardeners in natural area management, their continuous learning, and their generation of ecological knowledge. In a study of five-week urban youth programs that encompassed stewardship along with other environmental activities, Kudryavtsev et al. (2012) found increases in participants' ecological place meaning (i.e., they were more likely to recognize ecological attributes such as wildlife in their neighborhood) but not in place attachment; the authors suggest that the latter finding may be attributed to the longer time period needed to form place attachment. Similarly, nature-based leisure activities are associated with 'place-based sentiments and symbolism' and 'provide opportunities to establish and express individual identity, maintain a coherent self-narrative, and provide a sense of rootedness' (Williams and Patterson, 2008). In the context of higher education, Walck (2003) draws from Aldo Leopold to suggest we investigate the places we presently inhabit and their management as a means to ecological identity and a land ethic, and visiting campus and nearby natural areas as part of a structured course or workshop was associated with greater place identity among students (Lawrence, 2012) and changes in place meanings among faculty (Barlett, 2005).

Important to campus sustainability and student life more broadly, studies have linked sense of place to pro-environmental behaviors (Kudryavtsev et al., 2011; Stedman, 2002; Vaske and Kobrin, 2001) and to human health and well-being (Sampson and Gifford, 2010; Williams and Patterson, 2008). In addition, place attachment and positive emotions such as sense of pride and competence that emanate from hands-on stewardship may counteract the overwhelmingly negative messages students receive about the environment, which Dickinson (2009) claims can lead to anti-environmental behaviors intended to boost feelings of invulnerability in the face of perceived threats. Further, Sampson and Gifford (2010) have documented that refugee youth who have undergone stress see natural beauty as an important part of recreating place that positively impacts their mental well-being. Although university students may not experience the same level of challenges as resettled refugees, pressures emanating from the competitive academic and social environment on university campuses can lead to significant stress and potentially increase the risk of suicide (Keller and Silverman, 2001).

Based on this research, we can begin to explore a conceptual model that links stewardship not only to directly enhancing campus biodiversity and ecosystem services (Barlett, 2004; Franz, 2004), but also to human well-being and sense of place. Well-being and sense of place in turn may influence future environmental behaviors. We focus on sense of place and pro-environmental behaviors in our study of the student stewardship organization in Sections 4 and 5; but first we provide an overview of open space and natural area stewardship in university sustainability rating systems in Section 3.

3. Nature connectedness in higher education sustainability initiatives

In that spending time in nature through stewardship and other outdoor activities can foster both human well-being and pro-environmental behaviors (see Section 2 above), incorporating such activities into the practice and study of sustainability in higher education is important. However, university sustainability rating systems generally place little emphasis on open space and natural area management, and almost no attention is paid to engaging students in stewardship or more broadly connecting students to nature (Table 1). Within higher education sustainability ratings systems, mention of open space is variously found under operations and management with a focus on landscaping (e.g., Assessment Instrument for Sustainability in Higher Education, Roorda et al., 2009; Unit-based Sustainability Assessment Tool developed in South Africa, Togo and Lotz-Sisitka, 2009; Sustainability Assessment Questionnaire of the Association of University Leaders for a Sustainable Future, ULSF, 2009); or under environmental management in France's *Plan Vert* (Conference des Grands Ecoles, 2010). More thorough treatments are found in the National Wildlife Federation *National Report Card on Environmental Performance and Sustainability in Higher Education*, which includes landscaping indicators such as managing for wildlife, habitat restoration, and invasive species removal (McIntosh et al., n.d.), and in the *Global Reporting Initiative* (GRI) originally developed for use by business, which includes detailed criteria for biodiversity management and has been adapted for universities (GRI, n.d.; Lozano, 2006b). In the *Sustainability Tracking Assessment & Rating System* (STARS) widely used at US universities, less than 2 out of a possible 318 credits are related to open space and natural area management (AASHE, 2012). However, STARS is unique in its inclusion of points for having a student outdoor recreation program. Further, the *Sustainability Assessment Questionnaire of the Association of University Leaders for a Sustainable Future* includes how well the institution teaches its students 'a sense of place: the natural features, biota, history and culture of the region,' although details for how this can be accomplished through education are lacking (ULSF, 2009). Finally, although *Plan Vert* encompasses quality-of-life policy in its rating system, mention is made of solidarity, housing, culture, sport, and personal assistance, but not time spent in nature. Thus, in general, when open space and natural area management is included in university sustainability rating systems, it is not integrated into education and social indicators.

Despite this lack of emphasis in formal sustainability rating systems, university students often engage in campus stewardship. Community gardening, student farms, and tree planting are the most common hands-on resource management activities; less frequent is student participation in constructing bioswales, landscaping, and introducing goats on campus to control invasive species (AASHE, 2013). Active open space stewardship programs have been described for Ball State University, whose whole systems approach to sustainability encompassed campus reforestation (Koester et al., 2006); Emory University, where students removed invasive species and re-established native plants in a campus natural area (Barlett, 2004); University of ID, which engages students

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Table 1
University sustainability rating systems minimally address open space and natural area and management.

Rating system	Category and items
Assessment Instrument for Sustainability in Higher Education (AISHE) (Roorda et al., 2009)	**Operations** Garden management
Global Reporting Initiative (GRI) (GRI, n.d.) Graphical Assessment of Sustainability in Universities (Lozano, 2006a,b)	**Biodiversity** • Operational sites owned, leased, managed in, or adjacent to protected areas and natural areas of high biodiversity outside protected areas. • Description of significant impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value outside protected area. • Habitats protected or restored. • Total number of IUCN Red List Species and National Conservation List Species with habitats in areas affected by operations, by level of extinction risk. **Water** Water sources significantly impacted by withdrawal of water: biodiversity value (such as species diversity and endemism, total number of protected species) **Effluents and waste** Identify size, protected status, and biodiversity value of water bodies and related habitats significantly affected by the organization's discharges of water and runoff
National Wildlife Federation Campus Environment Report Card (McIntosh et al., n.d.)	**Setting and reviewing goals** Protecting natural habitats **Landscaping overall** • Native landscaping program • Program to provide food and shelter to attract wildlife • Habitat restoration • Identification and removal of invasive exotic species
Plan Vert (Conference des Grands Ecoles, 2010)	**Environmental management** • Develop a policy that promotes biodiversity • Set up a sustainable management system covering cultivated environments, green spaces and developed spaces (roads and car parks) • Set up a sustainable management system covering natural environments
Sustainability Assessment Questionnaire (SAQ) (ULSF, 2009)	**Operations** Sustainable landscaping (emphasizing integrated pest management practices, native plants, biodiversity, minimizing lawn, etc.)
Sustainability Tracking, Assessment & Rating System (STARS) (AASHE, 2012)	**Education and research** • *Organic garden: points (0.25) • Outdoors program: points (0.25) **Grounds** • *Native plants: points (0.25) • *Wildlife habitat: points (0.25) • *Tree campus USA: points (0.25) **Stormwater management** • Living or vegetated roofs: optional, no points indicated • Vegetated swales: optional, no points indicated **Indicates credits do not apply to all institutions* *Total STARS points possible: 318*
Unit-Based Sustainability Assessment Tool (USAT) (Togo and Lotz-Sisitka, 2009)	**Operations** Sustainable landscaping (emphasizing native plants, biodiversity, minimizing lawn, etc.)

AASHE, 2012, Conference des Grands Ecoles, 2010, GRI, n.d., Lozano, 2006a,b, McIntosh et al., n.d., Roorda et al., 2009, Togo and Lotz-Sisitka, 2009, ULSF, 2009.

in restoring an on-campus native Palouse ecosystem; and the University of MN, whose Living Laboratory initiative funds proposals to utilize campus grounds as a medium for testing innovative ideas and related learning (Walton and Sweeney, 2013). At George Washington University in Washington DC, the *Ecosystems Enhancement Strategy* includes six focus areas, two of which are relevant to campus green areas: 'strengthen habitat and optimize natural space' and 'encourage a natural urban environment that helps enhance physical, mental & social well-being' (Office of Sustainability (2012)). The plan further specifies strategies and targets for how the university can impact its own campus and its larger Chesapeake Bay watershed, and integrates natural space and wellness with other focus areas. For example, natural space management strategies include landscaping with drought-resistant plants and converting former parking spaces to green spaces through use of permeable surface technology, both of which would contribute to the water quality focus area, and strategies for the well-being focal area include stewardship (e.g., more volunteer hours in gardens), recreation (e.g., green campus walking tours), and education (e.g., street side arboretum for use as education tool). Similarly, natural space management is a target under other focus areas; examples include enhancing tree canopy and green cover as part of the healthy air and climate target; constructing green roofs, bioswales, and rain gardens to reach water quality goals; and using on-campus food gardens to achieve the university's sustainable food production goal.

Perhaps recognizing this growing stewardship movement on college campuses, AASHE recently published the *How-to-Guide: Promoting Sustainable Campus Landscapes*, which reflects the above literature review in claiming that sustainable campus landscapes enhance learning and contribute to mental and physical health through fostering outdoor leisure activities and reducing asthma and stress-related diseases (Walton and Sweeney, 2013). According to the guide, '"sustainability" as applied to the campus landscape means incorporating the efficiency and complexity of nature into the landscape, restoring damaged ecologies, increasing biodiversity, promoting human health, and providing secure livelihoods (while also managing expectations of the "campus aesthetic"). Importantly, this means that a campus landscape must be sustainable not only ecologically, but socially and economically as well

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if it is to contribute to an institution's resiliency and health in both the short and long term' (Walton and Sweeney, 2013, p. 2). Further, according to Denison University sustainability coordinator in the US: 'Outdoor sustainability initiatives like bioswales, tree plantings, and sustainable landscaping allow members of the campus community to see and touch sustainability in a way that can't be done with building operations or curriculum modifications. These outdoor initiatives can (and do) serve as a springboard that builds momentum towards other, larger sustainability endeavors' (Walton and Sweeney, 2013, p. 1). In short, in recent years, interest in integrating nature-related activities into campus sustainability programs appears to be growing.

4. The case of a student stewardship organization

In an effort to explore how the literature supporting integration of campus open space and natural area stewardship is realized in practice, we turn next to an exploratory study of sense of place and environmental behavior outcomes of a campus stewardship organization.

4.1. Methods

We used qualitative methods, consistent with the exploratory nature of the research, and the small number of participants in the student organization that served as the focus of the study. More specifically, we used a phenomenological approach in trying to understand how students experienced a common phenomenon (Creswell, 2013), in this case involvement in a student stewardship organization. Such an approach is consistent with our research question, which focused on how students connected their experiences in a student organization to their place attachment and place meanings related to the Cornell University campus, and to their learning and pro-environmental behaviors. Consistent with phenomenology, we describe objectively what the student organization did and who belonged, as well as individuals' experiences. We also describe our own involvement in the phenomenon, but attempt to bracket these experiences out of the analysis (Creswell, 2013).

4.2. Study context and participants

Our study focuses on Friends of the Gorge (FOG), which is one of over 800 student-run organizations at Cornell University. Located in central New York State and with an enrollment of about 14,000 undergraduates and 7000 graduate students, Cornell's campus is unique in that it is bounded on the north and south sides by two scenic gorges cut deeply into the bedrock, with dramatic views from trails and bridges. The university is situated on a series of steep, mostly undeveloped hills broken up by flat areas with buildings, and is about 1/3 open space by area. Further, the rural region surrounding the campus has many natural areas where students can enjoy hiking and camping, some of which are owned by the university. Thus, Cornell is somewhat unique in its opportunities for natural area stewardship, although many universities in North America, Europe, South Africa, and elsewhere pride themselves on their landscaping, and offer similar albeit perhaps more limited opportunities for open space and natural area stewardship.

FOG, whose mission integrates stewardship, recreation, and safety in the campus gorges, was founded in 2008 by the first author. FOG stewardship activities include trail improvement, tree planting, and gorge cleanups; recreation is focused on hiking and camping; and the students were involved in formulating university safe access policy following a suite of accidents and suicides in the campus gorges. The first author serves as faculty advisor to FOG; the second author's involvement was limited to this and related research on FOG outcomes.

In general, about 20 undergraduate students participate in FOG's ongoing activities during any one year. For this study, we chose 10 undergraduate students who were most active in FOG weekly meetings and recreational and stewardship activities. Half the students were female and half male, and they varied in undergraduate major and years since matriculation.

4.3. Interviews and analysis

We conducted semi-structured interviews with each of the 10 FOG students. The interviews, which lasted from 30 to 60 min, included questions about place attachment, place meaning, and environmental behavior (Table 2), as well as questions related to student engagement in campus natural area policy making, the results of which are reported elsewhere (Krasny and Delia, submitted for publication). All interviews were recorded and transcribed.

We followed general guidelines for phenomenological analysis including organizing data into meaningful clusters, identifying themes, and synthesizing meanings related to the experience (Patton, 2002). The second author used provisional and hypothesis coding for the first cycle coding to determine whether and how the elements of sense of place and any environmental actions or commitment to action were expressed, while also seeking novel, unexpected or contradictory codes (Saldaña, 2013). The first author next examined the files of all student transcript segments within a particular provisional or hypothesis-based code grouped together using Atlas-ti software, and recoded for meaning and assigned cross-cutting themes related to sense of place and environmental behaviors (Saldaña, 2013). Where interview quotes are included below, we have deleted distracting words (e.g., um, like).

To address validity, all student interviewees received a copy of their interview transcript for review and the second author conducted a focus group with FOG students to discuss and receive feedback on the preliminary findings of this study (cf. Mertens, 2005). However, the results are limited by potential sources of bias including that students self-selected into FOG, and their

Table 2
Study constructs related to sense of place and environmental behaviors, and the potential related FOG impacts, were addressed through semi-structured interview questions.

Constructs	Interview questions
Place attachment	Can you describe the level of your attachment to Cornell campus and surrounding area? ("Attached" is when you feel that this place reflects who you are, and you can do your favorite things in this place.)
Place attachment, FOG impact	How, if at all, has FOG influenced your attachment to the Cornell campus and surrounding area?
Place meaning	What places on the Cornell campus and in the surrounding area are especially important and meaningful to you? Can you describe what meaning these places have for you?
Place meaning, FOG impact	How, if at all, has FOG influenced the meanings the Cornell campus and surroundings have for you?
FOG behaviors	Describe all FOG conservation activities you have participated in during the semester.
Other conservation behaviors	Describe any other conservation and environmental behaviors you have demonstrated over the semester.
Environmental behaviors, FOG impact	Has FOG had an impact on your conservation or environmental behaviors? If so, how?

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answers, as well as the interpretation of the results, could have been influenced by the fact that one of the researchers was the faculty leader for the student organization. In addition, because of the small number of students interviewed and the fact that the research was conducted on only one campus and in only one academic year, this study only can be used to suggest the potential of student stewardship organizations; the results are not generalizable to other contexts.

5. Student perceived outcomes of engagement in nature-based stewardship and recreation

Environmental stewardship and recreational activities conducted as part of FOG appeared to contribute to students' sense of place, including place attachment and place meanings. In addition, several findings emerged from the interviews including how FOG activities were associated with relief from stress, wanting to give something back to the university and broader society, practical knowledge of the outdoors, perspectives on conservation, and in two cases professional choices. Although students found the nature based-stewardship meaningful and the recreational activities memorable, they did not generally connect these activities to changes in behaviors that focus on energy use and other aspects of campus sustainability.

5.1. Sense of place

FOG provided the opportunity and motivation for students to explore campus natural areas they would not have explored on their own. The students recognized how this contributed to their use of the natural areas beyond the FOG activities; such use of place for recreational activities is a component of place dependence, which, along with place identity, constitutes place attachment.

I guess, it's opened my eyes more to what's out there because I don't think I would ever have walked over to the Plantations [campus arboretum and natural area]. I don't know how many years would have gone by where I had never gone there, even though it's not that far but just, I wouldn't have, I'm not that brave enough to be walking around and explore the Plantations by myself. Yeah, so I'm glad that FOG has opened that up to me.

One student suggested that FOG motivated engagement in recreational and stewardship behaviors, which in turn influenced place attachment. He connected this place attachment with being able to 'give back' (i.e., help others or contribute to the greater good).

I think FOG helps motivate you to come out more and you know give back more so I definitely feel that it's made me more attached, made me even more appreciative than I already was about the landscape of the Cornell campus. You know the fact that I'm at a great school and made me feel good about what I can give back …

Place dependence also was evident in students' use of the natural areas as a means to reduce stress.

… partly because I've walked these areas with friends a lot so it kind of says 'friendship' to me and it also says 'escape.' Coming out of classes it's nice to be able to walk down that path past the trees and you walk over the bridge past Beebe Lake and you always see the falls and there's wildlife on the lake and usually when spring comes around I'll go to the Arboretum as things start to come back to life and it's just a good way to get away from all the stress of school work and everything else.

Importantly, the above quote also provides insight into the place meanings the students attributed to the natural areas, including social meanings ('friendship') and 'escape' from stresses of everyday life. Relative to place meanings, which along with place attachment comprises sense of place, the Cornell gorges have long been a symbol of the Cornell campus and alumni often talk about their memorable experiences in the gorges (e.g., there is a tradition of marriage proposals on the iconic suspension bridge over one gorge). The gorges also have negative meanings associated with suicides by jumping off bridges and accidental deaths due to drowning and falling. Through FOG, the students appeared to have developed new place meanings associated with hiking and acquired and created memories associated with specific places; along with place-based experiences, associated memories can be important in creating sense of place (Gooch, 2003).

So I think that the different places, their meaning behind them has a lot just to do with what you use them for and what they, they become symbols for …

More specifically, the students talked about the FOG stewardship activities, including trail maintenance and building projects, working with fraternities to sponsor gorge trash clean-ups, and tree planting, as being particularly meaningful to them personally. Some activities acquired larger symbolic meanings related to giving back in light of major challenges facing the US (responding to terrorism); alternatively stewardship was seen as an opportunity to make a small difference in a large university. In this way, the stewardship activities seemed to have created new place meanings associated with giving something back to the environment or society.

I think the one that was really cool was planting the trees, that was probably the most meaningful cause it was something I hadn't done in a really long time and especially, I mean, I don't know it just happened to fall, we happened to do it on September 11th so it kind of felt like giving back you know, had a little bit more meaning to it and plus it was really cool …

I thought both of the volunteering ones were particularly meaningful, like the tree planting and the puncheon [trail improvement] one because, it seemed like things that would've just been like forgotten about if no one had done it. Like I don't know, the university's so big and then I feel like it focuses a lot on big projects like make a new building or something but there's all these little things that are important and I think it's good that a club like us can do these sorts of things that kind of get forgotten about.

Whereas the students described the stewardship activities as meaningful, the recreational activities appeared to create lasting memories, perhaps in part because of physical and social challenges students faced on the hiking and camping trips.

I'd actually say more of the activities that are memorable in that they'll leave lasting memories when I go away from Cornell were actually more the recreation activities which is not to undermine any of the management things that we did …

Recreational activities also enabled students to address challenges and practice leadership. For example, a FOG student president described at length the challenges of leading inexperienced students on a camping trip in the rain and several students mentioned the bonding among students that occurred on hikes as being particularly memorable.

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5.2. Environmental learning and behaviors

FOG enabled students, nearly all of whom were from urban backgrounds, to learn practical skills including how to use a wheelbarrow and tools on the trail maintenance projects, how to plant trees and protect them from deer, and how to safely use natural areas. Referring to the dangers inherent to recreation in the gorges, a student recounted:

> *… if one of my friends was to say, 'Let's go gorge jumping or let's go hang out in the gorge,' I would be a lot more aware of, if you go gorge jumping here there's a pipe that sticks into the water or if you go swimming here, there's an undertow that's actually really dangerous and people have died here. … I'm much more aware of (the dangers) and would be much more likely to not go or try to persuade my friends not to go, or to go somewhere else where it's a little safer maybe.*

Several participants explained how multiple FOG activities over time, in concert with course work and other experiences, had shifted their perspectives on conservation. This finding is important in terms of reflection and critical thinking.

> *Well, it basically taught me … conservation isn't just you know the magical solution to everything. That there are difficulties in implementing it that in many cases there are advantages to not doing conservation work and that in pretty much every case, conservation when done needs to be done mindfully, there needs to be open dialogue and it needs to be a continuing process. So for instance, Adopt-a-Gorge never would have really meant anything if it was just one group doing a clean-up and then leaving it. What makes it important, what makes it significant is that it's enduring and that we continue to work on it and we continue to think about it and we stay open to new ideas, new ways of collaboration and new means for the program to expand.*

Another participant explained how her professional goals had shifted, again due to a combination of factors that she connected with her FOG experience. Interesting in this regard is the student's movement from adversarial to more collaborative and 'positive' approaches to environmental work through her engagement in stewardship.

> *I probably would have gone more towards the policy end of things …, I feel like it was cause I mean I wouldn't have had my relationship with Plantations which wouldn't have led me to Plantations which wouldn't have led me to the Forest Service. I would've definitely gone more towards policy and like environmental law and being an angry environmentalist. … As opposed to trying to do positive things to change things.*

Some students also expressed how FOG made them more aware of their pro-environmental behaviors.

> *I think it's sort of made me a lot more conscious about what I do, like at home we don't do compost or anything like that. I had a friend in high school who was very into it and like at the time I sort of never really thought twice about it but living in the house and being in FOG and all of that has really sort of changed my view on that.*

Despite the changes in conservation beliefs and goals, and active engagement in stewardship behaviors reported above, the FOG students did not feel their experience led to changes in environmental behaviors that were not directly related to FOG activities.

6. Incorporating nature-based stewardship in campus sustainability

By demonstrating how engaging in nature-based stewardship and leisure activities contributes to students' sense of place and desire to give back to the Cornell and broader community, the FOG case adds to a growing body of literature documenting the importance of experiences in nature to human well-being (Louv, 2006; Zelenski and Nisbet, 2012) and reinforces a smaller number of studies on the impacts of stewardship on sense of place (Krasny et al., submitted for publication; Ryan et al., 2001) and perception of ability to engage meaningful action (Kaplan and Kaplan, 2005). In particular, the FOG student organization provided opportunities for students to engage with nature in ways that otherwise would not have been accessible, including hiking and making trail improvements in campus natural areas, which contributed to their attachment to the campus and to meanings related to relieving academic stress through spending time in nature. FOG students also reported changes in conservation understanding and beliefs and positive feelings about their ability to take meaningful action. These results are consistent with Ryan et al.'s (2001) findings that volunteer stewardship contributes to greater attachment to local place, which in turn may spur a willingness to advocate for and defend cared for places against potential threats. In a related study, we have shown that FOG students became more broadly involved in campus natural area management and policy consistent with an adaptive co-management approach (cf. Armitage et al., 2007), which involved social learning and building trust among students and university administrators (Krasny and Delia, submitted for publication).

Despite these outcomes, FOG students did not report changes in individual environmental behaviors not directly connected to stewardship. This result is consistent with research showing that stewardship participants are more likely to engage in similar stewardship behaviors (e.g., plant native species on their own property, engage in outdoor recreation in natural areas; Ryan et al., 2001), and that nature-based recreation participants do not generally transfer outdoor experiences to changes in unrelated environmental behaviors such as recycling or reduced energy use in the absence of specific attempts to help them make those connections (D'Amato and Krasny, 2011). Thus, if a goal is to engage students in broader university sustainability actions, a more concerted attempt should be made to link stewardship and recreation to sustainability initiatives and environmental behaviors through student clubs, other out-of-class activities, and course work.

Mention of natural area management in campus sustainability often focuses on green infrastructure and associated ecosystem services. Some authors go further to demonstrate how students can be involved in the design and stewardship of campus green infrastructure, including green buildings, gardens, and natural areas (Orr, 1999; Upitis, 2007). Similar to student engagement in planning for green infrastructure, student involvement in hands-on stewardship can help provision ecosystem services (e.g., planting trees to absorb CO_2 or trail maintenance to reduce erosion). Such stewardship supports other aspects of campus sustainability and student life consistent with the Biophilic University, including cognitive, aesthetic, and emotional, in addition to academic experiences (Jones, 2013).

The question arises of why, despite the growing body of evidence about the wellness and environmental behavior outcomes of nature-based activities, open space and natural area stewardship is given only minimal play in campus sustainability documents in the

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US, Europe, and Africa. One answer may be found in the movement during the 1990's away from environmental education, which has roots in nature education and was seen as focusing on environmental protection while ignoring issues of social equity and economic development. In an effort to address these concerns, environmental education was in part replaced by Education for Sustainable Development (Mckeown and Hopkins, 2003), which lacks a focus on nature-based activities and which has influenced the sustainability movement in higher education (Wals, 2014). Other answers may be found in the overriding importance of climate change and to the fact that in contrast to natural resource management, climate change can be addressed through classes in what might considered more prestigious disciplines (e.g., engineering, business) and through high visibility changes in infrastructure (e.g., converting coal-fired power plants to natural gas).

Whereas a continued emphasis on greenhouse gas emissions, energy, recycling and other aspects of sustainability is critical, integration of open space and natural area stewardship into campus sustainability programs can support student engagement in these other activities. This can occur through the student wellness, sense of place, and commitment to conservation outcomes of nature engagement, which provide a basis for other kinds of actions. Nature-based programs that address personal fulfillment also provide an alternative to constant negative messaging about humans' impact on the environment, which may lead to emotions not conducive to well-being or pro-environmental behaviors (Dickinson, 2009; Fraser and Brandt, 2013; Naess, 2005). Finally, seeing and stewarding nature has positive outcomes in urban and other communities that face multiple environmental and social stresses, including strengthening social ties (Kuo et al., 1998), fostering a sense of competence (Kaplan and Kaplan, 2005), provisioning ecosystem services (Krasny et al., 2013), and contributing to individual and social-ecological resilience (Tidball and Krasny, 2014). Thus, incorporating such activities into campus sustainability efforts, including on urban campuses, may act to reinforce rather than distract from equity and related aspects of holistic sustainability (Jones, 2013).

7. Implications: towards a research agenda and an environmental virtues discourse

While the Cornell case has many aspects specific to the university's unique natural areas, opportunities to engage in community gardening, tree planting, native plant restoration, and similar stewardship activities are possible across many campuses and may have similar outcomes related to students' sense of place, stress reduction, and engagement in conservation related behaviors. Fortunately, even minor 'doses' of nature, such as are possible on more built-up campuses, can have positive impacts on mental well-being and cognitive ability (Kahn et al., 2008; Nisbet and Zelenski, 2011; Park et al., 2010). Another possibility for built-up campuses is to engage students in stewardship and restoration activities in nearby natural areas (Koester et al., 2006). Both on- and off-campus efforts will benefit from linking student conservation organizations with campus landscaping departments; working with instructors of horticulture classes that focus on open space and natural area landscaping; and engaging with parks departments, land trusts, and similar organizations in the nearby community. Further, our Cornell case, which began as a response to student suicides, demonstrated the potential for working with university mental health professionals to integrate opportunities for connecting with nature into student wellness policy.

Although this study was based on a small number of students, they participated in multiple activities. Given that stewardship initiatives often involve a similar small number of students, or are one-time activities (e.g., campus tree planting events), challenges exist in expanding on this work to incorporate larger and quantitative studies. One possibility would be to work with student farm and gardening efforts, which are perhaps the most common means for students to engage in nature stewardship and involve repeated nature contact. Future research also might consider cross-university studies to enable larger sample sizes, avoid pseudo-replication, and enable comparisons. A related research agenda could start by addressing the following questions: What are the differences in outcomes on student stress, feelings of competence, and cognitive functioning of engagement in various stewardship and other campus sustainability activities? What are the relative contributions of well-being (e.g., reduction in stress, feelings of competence), sense of place, and learning in influencing environmental behaviors? Under what conditions do nature-based stewardship and recreational activities foster participation in additional nature-based stewardship, other campus sustainability activities, and a broad suite of environmental behaviors? How might stewardship, recreational, and other sustainability efforts complement each other to best address climate and broader campus sustainability goals?

Perhaps the most important contribution of this work is its implications for the way in which we think about campus sustainability. Here we return to the roots of campus sustainability in notions of Education for Sustainable Development, and the emphasis in such sustainability discourses on including humans and social equity concerns alongside environmental conservation. Incorporating into such linked social-environmental discourse notions of how nature conservation and nature connectedness can foster human and community well-being, and can help humans realize their individual potential, would seem self-evident.

Addendum

Since writing this article, AASHE has published a new STARS manual with greater focus on natural area management. See: AASHE. 2014. STARS Technical Manual 2.0. Lexington KY, USA.

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References

AASHE, 2012. STARS Technical Manual. AASHE, Lexington KY, USA.

AASHE, 2013. Association for the Advancement of Sustainability in Higher Education.

Andersson, E., Barthel, S., Ahrne, K., 2007. Measuring social-ecological dynamics behind the generation of ecosystem services. Ecol. Appl. 17, 1267–1278.

Armitage, D., Berkes, F., Doubleday, N., 2007. Adaptive Co-management: Collaboration, Learning, and Multi-level Governance. University of British Columbia Press, Vancouver, British Columbia, Canada, p. 360.

Austin, M.E., Kaplan, R., 2003. Identity, involvement, and expertise in the inner city: some benefits of tree-planting projects. In: Clayton, S., Opotow, S. (Eds.), Identity and the Natural Environment: the Psychological Significance of Nature. The MIT Press, Cambridge, MA, USA, pp. 205–225.

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Barlett, P.F., 2004. No longer waiting for someone else to do it: a tale of reluctant leadership. In: Barlett, P.F., Chase, G.W. (Eds.), Sustainability on Campus: Stories and Strategies for Change. MIT Press, Cambridge MA, USA, pp. 67–87.
Barlett, P.F., 2005. Reconnecting with place: faculty and the Piedmont Project at Emory University. In: Barlett, P.F. (Ed.), Urban Place: Reconnecting with the Natural World. MIT Press, Cambridge, MA, USA.
Bouillion, L.M., Gomez, L.M., 2001. Connecting school and community with science learning: real world problems and school-community partnerships as contextual scaffolds. J. Res. Sci. Teach. 38, 878–898.
Branas, C.C., Cheney, R.A., MacDonald, J.M., Tam, V.W., Jackson, T.D., Have, T.R.T., 2011. A difference-in-differences analysis of health, safety, and greening vacant urban space. Am. J. Epidemiol. 174, 1296–1306.
Cafaro, P., 2001. Thoreau, Leopold, and Carson: toward an environmental virtue ethics. Environ. Ethics 22, 3–17.
Conference des Grands Ecoles, 2010. The Green Plan – National Framework.
Creswell, J.W., 2013. Qualitative Inquiry & Research Design: Choosing among Five Approaches. Sage, Washington DC, USA.
D'Amato, G.L., Krasny, M., 2011. Outdoor adventure education: applying transformative learning theory to understanding instrumental learning and personal growth in environmental education. J. Environ. Educ. 42, 237–254.
Dickinson, J.L., 2009. The people paradox: self-esteem striving, immortality ideologies, and human response to climate change. Ecol. Soc. 14, 34.
Faber Taylor, A., Kuo, F.E., Sullivan, W.C., 2001. Coping with ADD: the surprising connection to green play settings. Environ. Behav. 33, 54–77.
Farnum, J., Hall, T., Kruger, L.E., 2005. Sense of Place in Natural Resource Recreation and Tourism: an Evaluation and Assessment of Research Findings. US Forest Service.
Franz, A., 2004. Restoring natural landscapes: from ideals to action. In: Bartlett, P.F., Chase, G.W. (Eds.), Sustainability on Campus: Stories and Strategies for Change. MIT Press, Cambridge MA, USA, pp. 229–240.
Fraser, J., Brandt, C.B., 2013. The emotional life of the environmental educator. In: Krasny, M.E., Dillon, J. (Eds.), Trading Zones in Environmental Education: Creating Transdisciplinary Dialogue. Peter-Lang, New York City, NY, USA, pp. 133–158.
Fusco, D., 2001. Creating relevant science through urban planning and gardening. Int. J. Res. Sci. Teach. 38, 860–877.
Gooch, M., 2003. A sense of place: ecological identity as a driver for catchment volunteering. Aust. J. Volunt. 8, 23–33.
GRI, n.d. G4 Sustainability Reporting Guidelines: Implementation Manual. Global Reporting Initiative, Amsterdam, The Netherlands.
Hartig, T., Mang, M., Evans, G.W., 1991. Restorative effects of natural environment experiences. Environ. Behav. 23, 3–26.
Jones, D.R., 2013. 'The Biophilic University': a de-familiarizing organizational metaphor for ecological sustainability? J. Clean. Prod. 48, 148–165.
Kahn Jr., P.H., Friedmanb, B., Gillc, B., Hagmanb, J., Severson, R.L., Freierb, N.G., Feldmana, E.N., Carrèred, S., Stolyare, A., 2008. A plasma display window?—The shifting baseline problem in a technologically mediated natural world. J. Environ. Psychol. 28, 192–199.
Kaplan, R., Kaplan, S., 1989. The Experience of Nature: a Psychological Perspective. Cambridge University Press, Cambridge, UK.
Kaplan, R., Kaplan, S., 2005. Preference, restoration, and meaningful action in the context of nearby nature. In: Barlett, P.F. (Ed.), Urban Place: Reconnecting with the Natural World. The MIT Press, Cambridge, MA, USA, pp. 271–298.
Kaplan, S., Kaplan, R., 2001. Health, supportive environments, and the reasonable person model. Am. J. Public Health 93, 1484–1489.
Keller, M.B., Silverman, M., 2001. Safeguarding your Students against Suicide. National Mental Health Association, Alexandria, VA, USA.
Kellert, S.R., Wilson, E.O., 1993. The Biophilia Hypothesis. Island Press, Washington, DC, USA.
Koester, R.J., Eflin, J., Vann, J., 2006. Greening of the campus: a whole-systems approach. J. Clean. Prod. 14, 769–779.
Krasny, M.E., Crestol, S.R., Tidball, K.G., Stedman, R.C., 2014. New York City's oyster gardeners: memories, meanings, and motivations of volunteer environmental stewards. Landscape Urban Plan. (submitted for publication).
Krasny, M.E., Delia, J., 2014. Campus sustainability and natural area stewardship: student involvement in adaptive co-management. Ecol. Soc. (submitted for publication).
Krasny, M.E., Russ, A., Tidball, K.G., Elmqvist, T., 2013. Contributions of civic ecology practices to ecosystem services in cities. Ecosyst. Serv..
Krasny, M.E., Tidball, K.G., 2009. Community gardens as contexts for science, stewardship, and civic action learning. Cities Environ. 2, 8.
Kudryavtsev, A., Krasny, M.E., Stedman, R., 2012. The impact of environmental education on sense of place among urban youth. Ecosphere 3, 29.
Kudryavtsev, A., Stedman, R., Krasny, M., 2011. Sense of place in environmental education. Environ. Educ. Res. 18, 229–250.
Kuo, F.E., Sullivan, W.C., 2001. Environment and crime in the inner city: does vegetation reduce crime? Environ. Behav. 33, 343–367.
Kuo, F.E., Sullivan, W.C., Coley, R.L., Brunson, L., 1998. Fertile ground for community: inner-city neighborhood common spaces. Am. J. Community Psychol. 26, 823–855.
Lawrence, E.K., 2012. Visitation to natural areas on campus and its relation to place identity and environmentally responsible behaviors. J. Environ. Educ. 43, 93–106.
Leopold, A., 1949. A Sand County Almanac. Oxford University Press, New York City, NY, USA.
Louv, R., 2006. Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder. Algonquin Books, New York City, NY, USA.
Lozano, R., 2006a. Incorporation and institutionalization of SD into universities: breaking through barriers to change. J. Clean. Prod. 14, 787–796.
Lozano, R., 2006b. A tool for a Graphical Assessment of Sustainability in Universities (GASU). J. Clean. Prod. 14, 963–972.
Lozano, R., Lukman, R., Lozano, F.J., Huisingh, D., Lambrechts, W., 2013. Declarations for sustainability in higher education: becoming better leaders, through addressing the university system. J. Clean. Prod. 48, 10–19.
Mayer, F.S., Frantz, C.M., 2004. The connectedness to nature scale: a measure of individuals' feeling in community with nature. J. Environ. Psychol. 24, 503–515.
Mayer, F.S., Frantz, C.M., Bruehlman-Senecal, E., Dolliver, K., 2008. Why is nature beneficial?: the role of connectedness to nature. Environ. Behav. 41, 607–643.
McIntosh, M., Cacciola, K., Clermont, S., Keniry, J., n.d. A National Report Card on Environmental Performance and Sustainability in Higher Education. National Wildlife Federation, Merrifield VA, USA.
Mckeown, R., Hopkins, C., 2003. EE ≠ ESD: defusing the worry. Environ. Educ. Res. 9, 117–128.
Mertens, D., 2005. Research and Evaluation in Education and Psychology, second ed. Sage, Thousand Oaks CA, USA.
Miles, I., Sullivan, W., Kuo, F., 1998. Ecological restoration volunteers: the benefits of participation. Urban Ecosyst. 2, 27–41.
Müller-Christ, G., Sterling, S., van Dam-Mieras, R., Adomßent, M., Fischer, D., Rieckmann, M., 2014. The role of campus, curriculum, and community in higher education for sustainable development – a conference report. J. Clean. Prod. 62.
Naess, A., 2005. Self-realization: an ecological approach to being in the world. In: Glasser, H., Drengson, A. (Eds.), The Selected Works of Arne Naess. Springer, Dordrecht, The Netherlands, pp. 515–530.
Nisbet, E.K., Zelenski, J.M., 2011. Underestimating nearby nature: affective forecasting errors obscure the happy path to sustainability. Psychol. Sci. 22, 1101–1106.
Nisbet, E.K., Zelenski, J.M., Murphy, S.A., 2009. The nature relatedness scale: linking individuals' connection with nature to environmental concern and behavior. Environ. Behav. 41, 715–740.
Office of Sustainability, 2012. GW Ecosystems Enhancement Strategy. The George Washington University, Washington, DC, USA, p. 56.
Okvat, H., Zautra, A., 2014. Sowing seeds of resilience: community gardening in a post-disaster context. In: Tidball, K.G., Krasny, M.E. (Eds.), Greening in the Red Zone. Springer, New York City, NY, USA.
Orr, D., 1999. Reassembling the pieces: architecture as pedagogy. In: Glazer, S. (Ed.), The Heart of Learning: Spirituality in Education. J. P. Tarcher/Putman, New York City, NY, USA, pp. 229–236.
Park, B.J., Tsunetsugu, Y., Kasetani, T., Kagawa, T., Miyazaki, Y., 2010. The physiological effects of shinrin-yoku (taking in the forest atmosphere or forest bathing): evidence from field experiments in 24 forests across Japan. Environ. Health Prev. Med. 15, 18–26.
Patton, M.Q., 2002. Qualitative Research & Evaluation Methods. Sage Publications, Thousand Oaks, CA, USA.
Peters, S.P., Wals, A., 2013. Learning and knowing in pursuit of sustainability: concepts and tools for trans-disciplinary environmental research. In: Krasny, M.E., Dillon, J. (Eds.), Trading Zones in Environmental Education: Creating Trans-disciplinary Dialogue. Peter-Lang, NYC, NY, USA, pp. 79–104.
Pred, A., 1983. Structuration and place: on the becoming of sense of place and structure of feeling. J. Theory Soc. Behav. 13, 45–68.
Roorda, N., Rammel, C., Waara, S., Paleo, U.F., 2009. Assessment Instrument for Sustainability in Higher Education, 2.0 Manual, 2nd draft. AISHE, Tilburg, The Netherlands, p. 63.
Ryan, R.L., Grese, R.E., 2005. Urban volunteers and the environment: forest and prairie restoration. In: Barlett, P.F. (Ed.), Urban Place. Reconnecting to the Natural World MIT Press, Cambridge, MA, USA, pp. 173–188.
Ryan, R.L., Kaplan, R., Grese, R.E., 2001. Predicting volunteer commitment in environmental stewardship programmes. J. Environ. Plan. Manag. 44, 629–648.
Saldaña, J., 2013. The Coding Manual for Qualitative Researchers, second ed. Sage, London UK.
Sampson, R., Gifford, S.M., 2010. Place-making, settlement and well-being: the therapeutic landscapes of recently arrived youth with refugee background. Health & Place 16, 116–131.
Shrivastava, P., 2010. Pedagogy of passion for sustainability. Acad. Manag. Learn. Educ. 9, 443–455.
Sipos, Y., Battisti, B., Grimm, K., 2008. Achieving transformative sustainability learning: engaging head, hands and heart. Int. J. Sustain. High. Educ. 9, 66–86.
Stedman, R.C., 2002. Toward a social psychology of place: predicting behavior from place-based cognitions, attitude, and identity. Environ. Behav. 34, 561–581.
Stedman, R.C., 2003. Is it really just a social construction?: The contribution of the physical environment to sense of place. Soc. Nat. Resour. 6, 671–685.
Thomashow, M., September 2010. Nine elements of a sustainable campus. EcoStructure 7.
Tidball, K.G., 2012. Urgent biophilia: human-nature interactions and biological attractions in disaster resilience. Ecol. Soc. 17, 5.
Tidball, K.G., 2014. Trees and rebirth: social-ecological symbols and rituals in the resilience of post-Katrina New Orleans. In: Tidball, K.G., Krasny, M.E. (Eds.), Greening in the Red Zone. Springer, New York City, NY, USA, pp. 257–296.
Tidball, K.G., Krasny, M.E., 2014. Greening in the Red Zone. Springer, New York, NY, USA, p. 250.

Please cite this article in press as: Krasny, M.E., Delia, J., Natural area stewardship as part of campus sustainability, Journal of Cleaner Production (2014), http://dx.doi.org/10.1016/j.jclepro.2014.04.019

Tidball, K.G., Krasny, M.E., Svendsen, E.S., Campbell, L., Helphand, K., 2010. Stewardship, learning, and memory in disaster resilience. Environ. Educ. Res. 16, 591–609.
Togo, M., Lotz-Sisitka, H., 2009. Unit Based Sustainability Assessment Tool. A Resource Book to Complement the UNEP Mainstreaming Environment and Sustainability in African Universities Partnership. Howick, Share-Net, Howick, South Africa, p. 45.
Ulrich, R.S., 1984. View through a window may influence recovery from surgery. Science 224, 420–421.
ULSF, 2009. Sustainability Assessment Questionnaire. Wayland MA, USA.
Upitis, R., 2007. Four strong schools: developing a sense of place through school architecture. Int. J. Educ. Arts 8.
Vaske, J.J., Kobrin, K.C., 2001. Place attachment and environmentally responsible behavior. J. Environ. Educ. 32, 16–21.
Walck, C., 2003. Using the concept of land to ground the teaching of management and the natural environment. J. Manag. Educ. 27, 205.
Wals, A., 2014. Sustainability in higher education in the context of the UN DESD: a review of learning and institutionalization processes. J. Clean. Prod. 62, 8–15.
Wals, A.E.J., Jickling, B., 2002. "Sustainability" in higher education: from doublethink and newspeak to critical thinking and meaningful learning. Int. J. Sustain. High. Educ. 3, 221–232.
Walton, J., Sweeney, M., 2013. How-to-Guide: Promoting Sustainable Campus Landscapes. AASHE, Denver CO, USA, p. 29.
Warburton, J., Gooch, M., 2007. Stewardship volunteering by older Australians: the generative response. Local Environ. 12, 43–44.
Wells, N., 2000. At home with nature: effects of "Greenness" on children's cognitive functioning. Environ. Behav. 32, 775–795.
Wells, N.M., Lekies, K.S., 2006. Nature and the life course: pathways from childhood nature experiences to adult environmentalism. Child. Youth Environ. 16, 24.
Williams, D.R., Patterson, M.E., 2008. Place, leisure, and well-being. In: Eyles, J., Williams, A. (Eds.), Sense of Place, Health and Quality of Life. Ashgate Publishing Limited, Aldershot, UK, pp. 105–119.
Wilson, E.O., 1984. Biophilia. Harvard College, Cambridge, MA, USA.
Zelenski, J.M., Nisbet, E.K., 2012. Happiness and feeling connected: the distinct role of nature relatedness. Environ. Behav., 1–21.

Please cite this article in press as: Krasny, M.E., Delia, J., Natural area stewardship as part of campus sustainability, Journal of Cleaner Production (2014), http://dx.doi.org/10.1016/j.jclepro.2014.04.019