



Research

Campus sustainability and natural area stewardship: student involvement in adaptive comanagement

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ABSTRACT. University campus sustainability initiatives have proliferated over the last decade. We contend that such initiatives benefit from applying conceptual frameworks to help understand and guide their activities and from a focus on campus open space and natural areas management. Informed by an adaptive comanagement framework encompassing social learning, social capital, and shared action, we used semistructured interviews to examine student participation in the immediate response and longer-term policy formulation following a crisis that occurred in a campus natural area. Students exhibited social learning as demonstrated by reflection and the integration of new ideas through discussions with administrators and peers, as well as social capital through increased social trust, which led to a shift in perspective regarding norms of student-administrator interactions. Further, students participated in shared action, such as posting warning signs in dangerous areas, and importantly, through their contributions to longer-term campus natural area safety and recreational access policy. Three conditions explain student engagement in the adaptive comanagement process: the presence of a pre-existing student organization that had built bonding social capital and was committed to campus natural area stewardship, openness to multiple stakeholder viewpoints and commitment to action on the part of the university administration, and the presence of a crisis that spurred emotions and action. Based on these findings, we assert that student organizations can contribute to an adaptive comanagement process and that such a process is consistent with university and campus sustainability values related to the importance of student engagement, mental health, and learning.

Key Words: *adaptive comanagement; natural areas; sustainability; university*

INTRODUCTION

Campus sustainability initiatives have proliferated in the United States, focusing on recycling, energy use, carbon footprint, and related issues, while emphasizing student engagement and learning. In the past, relatively little attention has been paid to open space and natural areas management in campus sustainability assessment criteria used in Europe, Africa, and the United States (Krasny and Delia 2014) such as the 2012 version of the Sustainability Tracking, Assessment & Rating System (STARS 1.2; Association for the Advancement of Sustainability in Higher Education [AASHE] 2012). However, STARS 2.0 has expanded to include a broader range of criteria related to natural areas, as well as better integration of natural areas and open space management with other categories (AASHE 2012, 2014). STARS 2.0 includes criteria for two new categories: Grounds: Sustainable Landscape Management, which encompasses plant and soil stewardship and restoring wetland habitats; and Biodiversity, which calls for a management strategy to identify “vulnerable ecosystems and species on campus and prevent, manage, and/or remediate damage to natural habitats and sensitive areas” (AASHE 2014:177). Further, the Biodiversity category recognizes that “(i)dentifying and protecting the integrity of natural ecosystems can enhance the surrounding environment and improve the quality of campus and community life” (AASHE 2014:177). These new categories are also linked to the Curriculum—Campus as a Living Laboratory and Engagement—Student Life rating criterion, which offer examples of students monitoring insects to help inform campus integrated pest management and student involvement in campus gardens, farms, and fisheries programs.

To support its expanded focus on open space and natural area management, AASHE published the *How-to-Guide: Promoting Sustainable Campus Landscaping* (Walton and Sweeney 2013). The guide presents multiple reasons for integrating the campus landscape into sustainability initiatives, including that the landscape embodies the college’s values and outside image; provides space for study, recreation, and aesthetic appreciation; provides ecosystem services and human health and well-being benefits; serves as a living lab for research on ecosystem services; and can build awareness and engagement among the wider campus and surrounding communities, thus serving as a springboard to build momentum for other sustainability endeavors. Community gardening, student farms, and tree planting are the most common hands-on resource management activities; other examples include student participation in constructing bioswale gardens, introducing goats on campus to control invasive species, restoring on-campus native ecosystems, and a fund for proposals that utilize campus grounds as a medium for testing innovative ideas and related learning (Walton and Sweeney 2013; AASHE, <http://www.aashe.org>). Earlier open space and natural areas initiatives were instituted by Ball State University, whose whole-systems approach to sustainability encompassed campus reforestation and off-campus riverside restoration projects as part of community outreach (Koester et al. 2006), and by Emory University, which engaged students in invasive species removal and restoring native plants in a campus natural area (Barlett 2005). Although these and other authors (Franz 2004) suggest the importance of collaboration and building social connections to sustainable campus natural resources management, they do not explicitly outline a conceptual framework for such collaborations.

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One possible conceptual framework to examine campus natural area and open space management is adaptive comanagement (ACM, also referred to as collaborative adaptive management). ACM is defined as a management approach that encompasses “learning-by-doing, integrating multiple knowledge systems, emphasizing flexibility of management structures, and advancing collaboration through power sharing at multiple scales” (Plummer and FitzGibbon 2007:39). Because ACM’s focus on experiential learning and collaboration is consistent with AASHE’s emphasis on student and broader campus engagement in planning and implementing sustainability initiatives, we felt ACM would be useful in framing research and practice related to natural area and open space management.

In this paper, we expand on work on university sustainability initiatives by applying ACM as a conceptual framework to understand the process and potential of student engagement in campus open space and natural areas management. More specifically, we asked: How are components of an ACM process expressed by members of a natural area stewardship student organization who became engaged in formulating university policy in response to a crisis in campus natural areas? We focused on three components of the ACM process, i.e., social learning, social capital, and shared action, to understand student engagement in natural areas management (cf. Armitage et al. 2007, Plummer and FitzGibbon 2007). Our case, which involved natural areas and associated safety issues on the Cornell University campus, has unique features; however, it nonetheless provides insights into how using an ACM conceptual framework may inform broader campus sustainability initiatives.

Adaptive comanagement and campus sustainability

Campus stewardship and wider sustainability initiatives are by nature collaborative, often involving students, faculty, grounds departments, and central administrators. Additionally, such initiatives have potential for addressing the educational mission of universities through learning-by-doing and reflection. Krasny et al. (2009) described how university students became engaged in stewardship of local watersheds and small-scale, urban green patches as part of hands-on experiential and service-learning courses. Although we are not aware of any studies using ACM as a conceptual lens for understanding on-campus sustainability efforts, a report about Harvard’s Greenhouse Gas Taskforce describes an approach that involved learning and assessment of performance, and adapting governance structures and activities to address new needs (Clark and Vautin 2008).

ACM is used in situations that involve uncertainty and change, as well as interconnectedness among issues, across landscapes, and between people and place (Scarlett 2013). It integrates collaboration and adaptive management to address complex resource management issues (Armitage et al. 2007). Within the context of ACM, collaboration suggests that “rights and responsibilities should be shared among those with a claim to the environment or a natural resource” (Plummer 2009) and falls within a tradition of participatory approaches to resource management (Hickey and Mohan 2004). Adaptive management, first proposed by Holling (1978), is often precipitated by a disturbance or crisis, and stresses an iterative process of undertaking management actions as experiments, assessing their results, and adjusting the management approach as a result of

this feedback (Plummer 2009). ACM can assume multiple forms, including a local deliberative process focused on policy decisions facilitated by a university researcher (Plummer and FitzGibbon 2007), an emergent or grassroots process of hands-on stewardship (Ruitenbeek and Cartier 2001, Krasny and Tidball 2012), or a regional network of government and civil society organizations engaged in collective resource policy making and management (Olsson et al. 2007).

Reflecting collaboration and adaptation, respectively, social capital and social learning are integral to the ACM process and outcomes. Through the involvement of multiple actors and their interactions, ACM can build social capital, e.g., social connections and trust (Plummer and FitzGibbon 2007), which provides a foundation for further collaborative management (Ahn and Ostrom 2008). Social learning occurs through incorporating outcomes monitoring that provides feedback on the results of management interventions, and through a deliberative process in which multiple voices are brought to bear on a management issue (Cundill and Rodela 2012). Social capital and social learning in turn build adaptive capacity, which is critical given the constantly changing social and environmental context in which management interventions take place (Plummer and FitzGibbon 2007, Armitage et al. 2008, Diduck 2010, Löf 2010).

METHODS

This study was designed to gain an understanding of how university students experience engagement in campus natural area stewardship and related policy discussions using a predetermined, i.e., ACM, framework to guide our interview protocols and data analysis. Similar to other work that sought an in-depth understanding of the ACM process (Plummer and FitzGibbon 2007), we used qualitative methods rather than hypothesis testing and attempted to draw inferences based on our results and the wider literature. Because we focused on one case, i.e., the Cornell Friends of the Gorge (FOG) student organization, our ability to draw broad conclusions is limited. The first author (M.K.) is a long-term recreational user of the campus natural areas, founded and is the faculty advisor for the FOG student organization, and has been a member of university committees that make and implement recommendations to the university president about gorge safety and recreation. Thus, the study both reflects her inner perspective (Patton 2002) and introduces an “experimenter effect” that is an external threat to validity (Mertens 2005). At the time of this study, the second author (J.D.) was a graduate student at Cornell University and was not substantively engaged in campus gorge issues.

Cornell campus natural areas

The Cornell campus is bordered by Cascadilla Creek to the south and Fall Creek to the north, both of which form deep gorges. As unique natural features of the campus, the gorges have played an important role in campus culture and traditions throughout Cornell’s history.

The focus of this study was Fall Creek and its associated gorge and trails, which comprise a 25.6-acre designated Cornell Natural Area, situated between the main campus and popular student housing. Thousands of students walk back and forth to classes daily by crossing one of the dramatic bridges suspended hundreds of feet above the creek and its waterfalls, and the trails along the

gorge are popular with recreational hikers and joggers. Prior to 2010, students swam in the gorges and enjoyed sunbathing on the rocks by the water. Today, although swimming is strictly prohibited, the gorge provides scenic views, trails, plant and wildlife habitat, hydroelectric power, and a drinking water source for Cornell University, as well as research and teaching opportunities. The section of Fall Creek just north of campus is also a New York State designated Recreational River, which mandates preservation and restoration of its natural, scenic, and recreational qualities (Cornell Plantations 2014).

Precipitating crisis

Our case is situated within a natural resource management context, which was precipitated by a crisis related to student well-being and safety in the campus natural areas. After a rash of student suicides by jumping off bridges and fatal drowning accidents in the gorges, the university leadership launched a concerted effort to prevent future tragedies. At the time of this study, issues of gorge safety and access were being widely discussed by Cornell students and administrators.

The FOG student organization, whose mission integrates stewardship, recreation, and safety of the campus gorges, was founded in 2008. FOG students played a role in the overall campus discussions about gorge safety and access, while also engaging in gorge trash cleanups, hikes, trail improvement projects, and other activities consistent with the organization's threefold mission. Balancing safety and access had been a concern of FOG from the very beginning when the first author (M.K.) founded the club after the fourth in a series of student drownings over 22 years in a popular swimming area with a small waterfall. Immediately after the 2008 drowning, the university attempted to block off access to the trail leading to the swimming area, which the first author used routinely for recreation and respite. Access to the trail was reinstated after a railing was installed at the waterfront to signal the trail's end. FOG students took early action to work with the Natural Areas manager to design and install a series of signs indicating swimming dangers at this and other popular gorge swimming spots, prior to the university installing more permanent signs.

In winter 2010, a cluster of six suicides (cf. Fishman 2010, Vitelli 2012) propelled the university to take further action related to gorge safety. The university's immediate response was to install tall chain link fences along all seven campus and nearby city bridges to prevent further jumping suicides. The university then opened up a campus-wide discussion about longer-term "means restriction" on the campus bridges that would balance safety with traditional recreational uses. An outside architectural firm was hired to design more permanent means to prevent jumping from bridges that retained to the extent possible scenic views from the bridges. FOG students participated in discussions about balancing safety and access with university administrators, including the Director of Mental Health Initiatives, Director of Community Relations, and Director of Cornell Natural Areas, and in discussions about bridge means restriction designs with the architects. It was this process of engagement in formulating university policy on gorge safety and access that we investigated for its resemblance to ACM, as it has been described for water resources and other natural resources management issues (Armitage et al. 2007, Plummer and FitzGibbon 2007, Smedstad and Gosnell 2013).

Participants

We specifically chose 10 undergraduate students who were most active in FOG weekly meetings and recreational and stewardship activities. Students varied in gender, age, and undergraduate major.

Study constructs

Consistent with democratic and collective public goods notions of social capital, including common-pool property management (Putnam 1995, Pretty and Ward 2001, Ahn and Ostrom 2008), we defined social capital as "features of social organization such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit" (Putnam 1995:67) and included volunteer involvement, diversity of friendships, trust and shared values, understanding, and social norms in our analysis. While recognizing multiple definitions of social learning (Armitage et al. 2008, Muro and Jeffrey 2008, Reed et al. 2010), we defined social learning in the context of resource management as a process by which stakeholder interactions go beyond participation to concerted action that brings about policy change, or more generally a collaborative process among multiple stakeholders aimed at addressing management issues in complex systems (Schusler et al. 2003, Keen et al. 2005, Blackmore 2007, Ison et al. 2007, Mostert et al. 2007, Pahl-Wostl et al. 2007, Plummer and Armitage 2007, Plummer and FitzGibbon 2007, Armitage et al. 2008, Fernandez-Gimenez et al. 2008). In addition to social learning and social capital, shared action, as the intended outcome of ACM, was used as a construct to guide our interview questions (Plummer and Armitage 2007). We viewed social learning and social capital coupled with shared action as evidence of the ACM process occurring, and of student engagement in that process.

Interviews

Each semistructured student interview lasted 30-60 minutes and was recorded and transcribed. The mostly open-ended interview questions reflected components of social learning, social capital, and shared action, and were informed by Plummer and FitzGibbon's (2007) notions of ACM as applied to small-scale management contexts that emphasize learning and participation consistent with our management context and with university norms (Table 1). Note that the interviews were conducted in the fall after a cluster of student suicides involving jumping into the campus gorges the previous winter. At the time of the study, issues of safety and access were being widely discussed by Cornell students and administrators.

To help address issues of validity, we also conducted three semistructured interviews of campus administrators that lasted 30-60 minutes and focused on administrators' views about student involvement in the gorge safety policy process. The interview questions reflected social capital, social learning, and shared action constructs similar to those in the student interviews.

Data analysis

All interviews were transcribed and coded by the second author (J.D.) using Atlas.ti software. She used provisional or hypothesis coding, which uses predetermined lists of codes generated from the literature (Table 1) during the first-cycle coding to determine whether the social learning, social capital, and shared outcomes concepts were present in the data, while also seeking novel, unexpected, or contradictory codes (Saldaña 2013). The first author (M.K.) next went through the files of all student transcript

Table 1. Social capital, social learning, and shared action: constructs and semistructured interview questions. FOG = Cornell’s Friends of the Gorge student organization.

Element	Constructs	Interview Questions
Social Learning		
Plummer and Fitzgibbon (2007)	Interaction, inclusion, and negotiation	Related to your involvement in FOG, please describe any discussions you can recall that entailed different members or participants in an activity sharing their perspectives on an issue (e.g., safety, management)
	Integration	Have you gained any new perspectives, knowledge, or points of view through participation in FOG? If so, please describe.
	Reflection and reflexivity	Have there been any instances where you have seen yourself and/or other FOG participants reflect on their actions related to gorge management (recreation, safety, stewardship) and modify them after reflecting? If so, please describe.
	Multiple loop learning	Have there been any important changes in the way you go about your life as a result of participation in FOG? If so, please describe.
	Systems orientation	How would you describe the relationship of humans and the environment? Has engagement in FOG influenced your views? If so, how?
Social Capital		
Civil society/ collective action tradition (Putnam 1995, Ahn and Ostrom 2008)	Associational and volunteer involvement	Please describe your engagement in FOG. What activities have you been engaged in?
	Civic leadership	Please describe any leadership activities you are engaged with in FOG.
	Social Trust	How would you describe the nature of the relationship between Cornell students and administrators responsible for natural areas management? Has FOG played a role in developing trust among Cornell stakeholders involved in natural area management? If so, please describe.
As a contributor to adaptive comanagement (Plummer and FitzGibbon 2007)	Diversity of friendships	Have you developed new friendships through FOG? If so, how are these people different from you and from the friends you have made otherwise at Cornell?
	Participation in networks, bonding / bridging / linking	Describe the nature of any bonds or relationships you have established with other students through FOG. How is FOG linking with other student groups? How has FOG linked with Cornell administration and other nonstudent groups?
	Shared values and shared understanding	Describe your views on the issue of gorge safety vs. access.
Shared Action	Social norms-elements of accepted, desirable actions	Describe the accepted or expected social norms in terms of student/administration interaction related to gorge management (e.g., cooperation, trustworthiness, openness). Can you describe any instances when these norms have been violated in management of the gorges?
	Shared actions / experiments	What are the memorable shared actions or activities you took part in through FOG? What management actions were taken as a result of FOG? What have you learned through these activities?

segments within a particular provisional or hypothesis-based code and recoded them for meaning and more cross-cutting themes. She then read the administrator interviews for global meanings but did not code them. Thus, we used general observations from the administrator interviews to provide another perspective on the student findings. To further address validity, all student and administrator participants received a copy of their interview transcript for review. The second author then conducted a focus group with FOG students to discuss and receive feedback on the preliminary findings of this study (cf. Mertens 2005).

FINDINGS

In presenting the findings, we integrated multiple ACM constructs from Table 1 into five cross-cutting themes that emerged from the student interviews: (1) engagement in the policy process, which incorporates elements of social learning; (2) shared action; (3) associational/volunteer involvement and civic leadership; (4) diversity of friendships, bonding and bridging; and (5) systems

orientation. We present evidence for the ACM process for each of the themes in the form of quotations from student interviews. For ease of reading, we eliminated speech pauses such as “like” and “sort of” from the quotes. An asterisk indicates inaudible words in the recordings.

Engagement in the policy process, or social learning

Immediately after the suicides, the students expressed a mistrust of administrators as well as emotional reactions to the tragedies and to the university’s initial response of erecting unsightly fences. However, through the process of meeting with administrators and their peers, the students demonstrated multiple aspects of social learning including interaction, inclusion, and negotiation; integration of new perspectives; reflection; and multiple-loop learning as suggested by their questioning of and reformulating their initial positions on gorge safety. We illustrate how these changes occurred over time with quotations from multiple student interviews below.

Following the installation of the chain link fences on the bridges after the suicide cluster, and at the start of the campus-wide deliberations, the students expressed strong views both for and against the fences.

I'd prefer there be fences and it really angers me when people are like, "Oh, they should prefer aesthetics over human life," I'm like, "I prefer students to be alive. ..." (AF, female)

...there's the feeling that, "Oh my God, they're fencing off our gorges. ..." There's anger that they are doing that to us. (HS, female)

FOG students were not accustomed to interacting with campus administrators and felt the lack of such engagement was the norm across campus.

I feel like there's the administration, there's the students, and they always know what the other group is doing to a certain extent but in terms of easy, direct communication between the two, it's usually not there. ... (XA, male)

Despite their perception of limited communication with administrators, students were included in discussions, forums, and informal meetings about gorge safety, and reflected on the viewpoints expressed. Means restriction was the term used for fences and other ways to restrict gorge access.

*Well, in the beginning, to be honest, when the fences first went up I was one of the indignant, irritated people who just took one look at those and was like, "that's hideous, do they really think that's gonna do anything? This is horrible, and I hate it and I wanna tear it down." But over the course of the meetings that I attended through FOG, I was introduced to the other perspective and to the necessity for means restriction even if it is ugly. And I definitely look forward to the future wherein I hope that * the architects, and whoever else is involved from our school, will be able to have means restriction that isn't so disgusting, and that adds to the landscape rather than detracts from it.* (HZ, male)

In that the students changed their views after reflection, they demonstrated a form of multiple-loop learning.

I do think that it forced me to think more about, like just looking at the fences, I feel like the surface view is, "I don't want them here, I want them down," instead of stopping to think deeper like, "Ok, why are they here? How are they helping other people?" Instead of focusing on yourself necessarily. (AR, female)

Students struggled to define their position, again demonstrating their capacity to reflect on and integrate other perspectives, and to change their views on how to balance safety and access.

I mean I feel like it definitely makes you think twice about what you're doing and you consider a lot of different aspects to something. Like you're looking at your own safety, you're looking at other people's safety, you're looking at preservation of the environment, you're looking at how administration's gonna react. (AR, female)

Students' views on student-administration communication norms also evolved from perceived limited communication and distrust

to feelings of respect and appreciation for the willingness of administrators to engage in discussion. Referring to a meeting with the directors of Mental Health Initiatives and Community Relations, a student stated:

*It was really interesting just to hear their opinion because we get the student opinion, like maybe a tiny bit * of a faculty or a graduate student point of view, but to know what the university thinks, what their rationale is, definitely helps. And to have someone physically sitting there and listening to you, and saying "I understand, I'm gonna take notes on this, I'll follow up on this" definitely helps.* (XA, male)

In short, through ongoing discussions with administrators and fellow students, FOG students demonstrated their ability to be reflective, to form bonds and new communication norms with administrators, and to change their perspectives.

I'm pretty sure that after participating in discussions, after hearing what we've heard about the necessity for means restriction, we've all come to realize that that actually is a necessity instead of just being upset about it because it ruins the view and removes us one more step from actually getting to experience these places of natural beauty. And I think in the beginning many of us if not all of us were upset. But as we've had discussions among ourselves and with university officials as we've sat in on talks, all of our viewpoints have matured. We've come to realize, as I said, the necessity for these barriers and we've come to hope that over time, a more pleasing solution can be found. (HZ, male)

Shared action

Students engaged in shared action related to both gorge safety and natural resources stewardship. Prior to the suicides, the students, frustrated by the slow university response to drowning accidents, demonstrated shared action through designing and posting their own warning signs in danger spots. Students recognized their ability to take action on their own but also that their actions were part of the larger policy and means restriction design process.

The signs are definitely important and it's definitely a good first step but we can't just leave it at the signs. I think we have to take it further in terms of actually either getting a permanent sign or getting some type of education campaign that might be modifying the trails to reflect our goals. And also in terms of the architects and meeting with them. We've gotten our opinions across, we have to. Ideally they'll come back at some point and go on a tour that we can, that we can actually show them, here's a bridge and here's what it's used for and here's what we want it to be used for and here's what we want it to look like. (XA, male)

The student also talked about what he learned from the sign project regarding official university response in the context of the drownings and FOG's grassroots action.

...what I've learned from them is the difficulty behind making change in terms of a bureaucratic system and in terms of a large population—people who for the most part don't really know a lot about what we're doing or

just wouldn't interact with us or with the trails maybe in the same way that we might as FOG. But also what we can actually do even though it might take time, that we kind of have an effect even if it won't be in the course of the semester, or in the course of a year or two. (XA, male)

To the extent that they participated in discussions and wrote a position paper about balancing gorge safety and access to natural areas, the students could be said to have engaged in shared action related to university policy.

One of the other management actions I guess would be writing the bridge barrier response, the means restriction response which was just really interesting, collecting everyone's views and trying to form some kind of cohesive response from that. (AR, female)

The students also referred to shared actions related to stewardship, including tree planting, trail maintenance, and organizing other student groups to conduct gorge cleanups. Lessons from these activities encompassed everything from organizational skills to learning how to construct a drainage ditch. One student suggested that working together on these projects and participating in the recreational activities set the stage for further shared actions.

I feel like I've learned lessons about people working together and then how when you're working with people who shared your interest, it strengthens your desire and your interest and hopefully leads to further such activities. (EN, female)

Other ACM elements were incorporated into shared actions. For example, a student reflected on what actions FOG could take to have the most impact on gorge safety, questioning actions that had been suggested by a university administrator. Referring to a study in which FOG students were asked to use clickers to record numbers of people walking across a gorge bridge, he commented:

...our whole idea of doing clickers for the Fall Creek Management Plan ... and then after thinking about it, we kind of thought that oh maybe this isn't the most effective thing for us to be doing. Which I thought was more important because now I think the signs are way more important in that every time I go down to the bottom of the gorge and think no one knows that there's like undertow here, that's way more important than knowing the number of people crossing the bridge at whatever time. So I think it's important and that we do reflect, 'cause usually after every activity we'll be, oh, what did you like? Or, what would you change? (EG, male)

Associational/volunteer involvement and civic leadership

Associational involvement and civic leadership, including negotiating shared responsibilities, were expressed through shared action related to safety and hands-on stewardship activities. The student who provided leadership for making and installing signs warning of the dangerous swimming areas commented:

The Fall Creek management sign putting up would be the thing that I took part in the most and it was kind of shared responsibility in that I organized all of it but we kind of worked together. ... I guess I learned that it really

is important to have everyone informed about what's going on and you can't just start taking steps on your own without telling people what's important about it or why because then they'll feel like they're just doing it because they have to rather than like realizing what's the rewards. And so I guess just keeping everything relatively open and informative is what I've learned is important. (EG, male)

Through the club's stewardship activities, i.e., trail maintenance, tree planting, and working with fraternities to sponsor gorge trash cleanups, and their recreational hiking and camping, students gained additional leadership and associational involvement experience. Reflecting on the challenges of a FOG program to organize fraternities to do gorge trash cleanups, a student commented:

The one activity which I really think was an opportunity to exercise leadership was the [Adopt-A-Gorge] program because I had to coordinate with all these people and make sure everyone left happy and at times that was difficult but it always ended up working out. (AZ, male)

Diversity of friendships, bonding and bridging

Students reported that their FOG friendships were unique in that the group brought together individuals from a variety of academic majors around common stewardship and recreational interests.

And so if there's someone who's just completely outside your group of friends, and who you don't share any academic interests with, it's really hard to meet them and become actual friends with them. ... So FOG definitely gave me an opportunity to meet new people. ... (XA, male)

In particular, students bonded with each other through their common concern for the environment and through having fun together.

I think I've developed a lot of friendships. ... I think they're pretty important to me because I'm just like a person in general that cares a lot about the environment and what impacts people have on it and I feel like it's a topic that really doesn't come up in general conversations with me and my other friends. ... (EG, male)

Planning stewardship events allowed connections to be made with other organizations on and off campus. Through this sort of bridging across organizations, there was the potential for wider impact.

We have our Adopt-a-Gorge program ... it's working with APO [fraternity] and other groups to clean up the gorges which is definitely good because FOG is sort of acting as a coordinator and an organizer ... and then ... to reach out to other groups and have them do the actual work and educate them a little bit. (XA, male)

Systems orientation

Several students explained the ways in which FOG both challenged and reinforced what they believed and were learning in their classes regarding understanding natural systems. In that the students' comments reflected a more integrated social-ecological view, with humans as part of nature, we refer to this result as changes in systems orientation.

Many of the members in FOG I would say have introduced me to a much more practical approach to dealing with nature. More of a conservationist approach rather than an environmentalist approach. And I think that's been very valuable for me who came in, you know, a diehard liberal with certainly strong convictions if not necessarily well-thought-out ones. And FOG is one of the things, one of the forces that has helped me in changing, maturing, and growing my view on how humans can interact with nature and what the right way to go about doing that is. (AZ, male)

The FOG activities reinforced an integrated human-nature systems orientation that this student learned about in a Natural Resources class.

I think it's reinforced some ideas that have come up in class. And things like trail maintenance I kind of struggle with 'cause you're reconstructing nature and you're making it so that people can use it but at the same point, now that I'm getting kind of a feel for how humans and the environment should be interacting, it's not as big a deal to me as it might have been otherwise. (EN, female)

Finally, a student talked about how FOG had changed her views about humanity.

FOG hasn't really influenced my views about our relationship with the environment. If anything, it's given me some sort of faith in humanity and our ability to not screw everything up and to make the world a little bit better. Even just through talking to people at different FOG events. You know, I don't understand the point in recycling or composting or anything, the world's going to hell in a hand basket, but at the same time when you talk to people who are actually doing things, you're like "Oh, maybe if everyone was like that the world would be. ..." So, it hasn't, FOG hasn't impacted me, the people around FOG have. (HS, female)

DISCUSSION

Our findings shed light on how members of a university student organization, whose mission encompassed safety, stewardship, and recreation in campus natural areas, engaged in an ACM process. In particular, through participating in a series of discussions about how to respond to a suicide crisis, students demonstrated the ability to listen to others' views, to reflect and change their own views, and to contribute to a new set of gorge safety and recreational access policies. In seeking an explanation for why FOG students were able to engage in multiple aspects of an ACM process, it is instructive to examine factors that contribute to ACM and related social learning in more traditional resource management contexts.

A first set of factors that contribute toward successful ACM outcomes relate to the resource itself, including well-defined, small-scale resource systems, clear property rights, and shared interests concerning the resource of an identifiable set of actors; these factors may be broadly present in campus open space and natural areas management (Armitage et al. 2009 as summarized in Plummer 2009). A second set of factors relate to the characteristics of those in power and include welcoming multiple

perspectives in deliberations, commitment to taking action, and providing training and resources; in short, provision of a supportive policy environment (Armitage et al. 2009 as summarized in Plummer 2009, Cundill and Rodela 2012). Third, characteristics of ACM participants include willingness to embrace plurality of knowledge, which is more likely to occur if trust and social relationships are already in place (Plummer and FitzGibbon 2007). Finally, ACM is likely to lead to significant outcomes, as well as a longer-term commitment to collaboration and changes in governance, if a threat or crisis motivates action and if the issues addressed are salient and broader than short-term solutions to single issues (Cundill and Rodela 2012, Smedstad and Gosnell 2013).

Reflecting the importance of an administration's openness and commitment to taking action, which is key to ACM, Shriberg (2002) found that a diverse core of stakeholders coupled with support from top campus leaders are important drivers of campus sustainability initiatives, and that the ability of individuals to interact on a regular and collegial basis is a key factor in success of these efforts. In the Cornell University natural areas case, once having taken immediate action to resolve the crisis by erecting fences, campus administrators were committed to engaging the broader campus and surrounding community in devising a long-term policy addressing gorge safety issues. The controversy spurred by the fences and the recognition of the gorges as a resource unique to the university may have motivated this commitment. Paralleling how the students' thinking evolved through the ACM process, the university Director of Mental Health Initiatives became convinced, through the ongoing discussions and reading studies about nature connectivity and mental health, that providing access to nature was a critical aspect of both the response to the gorge crisis and longer-term student mental health policy. As a result, he later incorporated nature access into Cornell's student mental health policies and initiatives.

Before engagement in the university-level ACM process, FOG students had hiked, conducted stewardship activities such as tree planting, litter cleanups, and trail improvements, and had taken action to address safety, i.e., erected signs in the gorges, all of which enabled them to build trust and leadership. Through these nature-based activities, students also developed a strong place attachment related to the gorges and a sense of well-being, which in addition to social capital may have contributed to their desire to engage in the discussions about gorge management (Krasny and Delia 2014). Similarly, Hanifan (1916) and Plummer and FitzGibbon (2007), working in radically different contexts and time periods, both noted the importance of social gatherings such as picnics that build social capital as a precursor to collective action for the common good. Social capital has been shown to play a role in the success of ACM and related longer-term adaptive responses to disturbance (Pahl-Wostl 2006, Blackmore 2007, Fabricius et al. 2007, Ahn and Ostrom 2008, Cundill and Rodela 2012), as well as to whole-systems approaches to campus sustainability (Koester et al. 2006, McMillan and Dyball 2009).

A culture supporting pluralism and student organizations that integrate recreation and service, and thus may foster trust and bonding, are common on university campuses; however, the fact that the Cornell case was precipitated by a local crisis makes it

unusual. According to Fabricius et al. (2007), communities respond to change either by ad hoc and reactive coping strategies aimed at short-term survival, which depend on technology and lack a larger long-term vision or visionary leadership, or by evolving proactive adaptive strategies that promote longer-term social-ecological well-being through shared social learning and institutional change. Cornell University displayed both short-term responses, i.e., erecting fences, and a longer-term strategy of engaging the campus in deliberations that led to reducing the risk of suicides and accidents while enabling safe, albeit more limited, recreational access. Further, in incorporating nature access into student mental health policy, the university displayed a longer-term adaptive strategy. Since the resolution of the suicide crisis, an ongoing process for ACM of the campus gorges has been put in place in the form of the Cornell Gorge Safety Committee. This group may be viewed as a new governance arrangement in that it continues to monitor policies and suggest changes related to safety, education, and access. However, it is important to recognize that FOG was only one of multiple institutional players that contributed to the resolution of the gorge crisis and this longer-term strategy, and that after the issue of gorge suicides was resolved, there has been only minimal student involvement in ongoing ACM. This is to be expected at universities, whose transient student body has little awareness or memory of what occurred before they arrived on campus, and in the absence of a current crisis (cf. Smedstad and Gosnell 2013).

In short, it appears that three conditions can explain the Cornell student engagement in the ACM process. These include the presence of a pre-existing student organization whose members had built social capital and were committed to campus natural area stewardship, openness and commitment to action on the part of the university administration, and the presence of a crisis that sparked an emotional response as well as action to resolve longer-term natural areas management issues.

CONCLUSION

Despite the unique features of the Cornell case, ACM may provide a conceptual framework for understanding and designing campus sustainability efforts. Rather than being precipitated by a crisis unique to a particular campus, university sustainability initiatives appear to be driven by students' and university staff's perceptions of an environmental and social justice crisis, as well as by the STARS and other sustainability rating systems. Through STARS, AASHE acts to monitor university progress toward a set of sustainability goals; a system for monitoring is critical not only to learning-by-doing and adaptive management, but also to policing bad actors in common-pool resource management (Dietz et al. 2003, Schlager 2004). Because universities compete among each other for gold and platinum STARS ratings (Friedlander 2013, Cornell University 2014), as well as for prospective students seeking a "green" university, the STARS monitoring system creates outside incentives for sustainability policies. Although such incentives are not a focus of the ACM literature, similar cross-site monitoring systems exist outside of universities, e.g., the Urban Biosphere Initiative system for recognizing cities whose policies foster biodiversity and provision of ecosystem services (ICLEI, <http://urbis.iclei.org/>). Further, by sharing sustainability practices across campuses through its e-newsletter, website, publications, and conferences, AASHE functions as a bridging

organization across universities; in natural resources management, bridging organizations serve to scale up small local efforts to a regional ACM system (Olsson et al. 2007).

Our work suggests a path forward for AASHE's campus landscaping, biodiversity, and other sustainability efforts. First, administrators should consider supporting nature-based recreation and stewardship, which fosters connections and trust among students and staff, sense of place, psychological well-being, and ecosystem understanding, all of which can be drawn on for adaptive management and for designing policies on an ongoing basis and in the event of a crisis. Second, campus administrators can promote a culture of openness and commitment to long-term capacity building and action, which may foster student trust, engagement, and learning that can be leveraged beyond a particular crisis to support longer-term sustainability goals.

Responses to this article can be read online at:

<http://www.ecologyandsociety.org/issues/responses.php/6787>

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