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Author:
Javier, Alexander
Jones, Darryl
Tannenbaum, Sara Rose

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Our study attempts to assess how different methods of engaging student volunteers on Berkeley's campus impact student's enthusiasm for stewardship, such as their willingness to participate in future on or off-campus restoration projects. Using a questionnaire and targeting four different undergraduate student groups, including students who lived adjacent to Strawberry Creek, we attempted to gauge their current involvement and future involvement in stream restoration activities. We found that academic work is the strongest method of engaging student volunteers and that some form of spontaneous use is the best indicator of each student's enthusiasm for future stewardship. In summary, student stewards can provide the link between academic solutions and collaborative engagement with urban creeks.

Types of Student Engagement and Commitment to Stream Stewardship: Strawberry Creek on University of California at Berkeley Campus

By Alexander Javier, Darryl Jones, and Sara Rose Tannenbaum
LA227 River and Stream Restoration
Professors G. Mathias Kondolf & Philip Williams
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Abstract

Our study attempts to assess how different methods of engaging student volunteers on Berkeley's campus impact student's enthusiasm for stewardship, such as their willingness to participate in future on or off-campus restoration projects. Using a questionnaire and targeting four different undergraduate student groups, including students who lived adjacent to Strawberry Creek, we attempted to gauge their current involvement and future involvement in stream restoration activities. We found that academic work is the strongest method of engaging student volunteers and that some form of spontaneous use is the best indicator of each student's enthusiasm for future stewardship. In summary, student stewards can provide the link between academic solutions and collaborative engagement with urban creeks.

Introduction

The first step to stream restoration is building community support (Riley 1998). Furthermore, public support is important for continued care of river restoration projects after their implementation (Kondolf & Yang 2008). However, engaging communities and achieving a shared understanding of what is desirable for local streams is a challenge for urban water management (Walsh 2005). Literature demonstrates that engaging the community through stream education, spontaneous use, "volunteerism", and direct participation can instill a sense of communal watershed ownership and stewardship (Riley 1998; Hester 2006; Chanse &Yang 2005; Mozingo 2005; Kondolf & Yang, 2008).

Beginning in the 1980's, faculty, staff and students at the University of California, Berkeley transformed an "unsightly… sewage- begrimed" Strawberry Creek into a celebrated example of urban creek restoration. On-campus portions of Strawberry Creek are described as a "best attainable condition" for urban streams in the area (Charbonneau & Resh 1992; Purcell et. al. 2002, pg 266). Success is attributed to the strong support of campus administration, funding and a faculty-based Creek Committee (Charbonneau & Resh 1992). Other reasons for success include: wide institutional jurisdiction over land use policy and management, institutional memory, an educational setting of monitoring, research and restoration, and consistent "free" research, leadership and labor from students (T. Pine, UC Berkeley Environmental Health and Safety, personal communication, October 2011; D. Pon and T. Grinberg, Students of Strawberry Creek Restoration Project, personal communication, September 2011).

Our study attempts to assess how different methods of engaging student volunteers on Berkeley's campus impact student's enthusiasm for stewardship, such as

their willingness to participate in future on or off-campus restoration projects. We also attempt to evaluate to what extent prior exposure and residence proximity (i.e. spontaneous use) impacts student enthusiasm.

Two hypotheses guided us in this study:

1) Involvement in academic work, specifically courses and research, is the leading means of recruiting students for stream restoration work on the U.C. Berkeley campus, *but*
2) Prior exposure and residence proximity (i.e. spontaneous use) is a stronger indication of individual student enthusiasm than recruiting through academic work.

Methods

To measure how student engagement in stream restoration activities relates to enthusiasm for stewardship on the UC Berkeley campus, we designed a 10-minute student questionnaire (Appendix A). This 14-question questionnaire was distributed to three experimental groups and one control group for a stratified statistical sample (Fig. 1). The three experimental groups were selected to encompass the scope of student stream interactions from academic (institutional) involvement to spontaneous use by living by it (Appendix E). To maintain objectivity in the sample groups we did not disclose the objective of the questionnaire unless asked directly. (Note: "Decal" is short for "Democratic Education at Cal" a student-taught seminar. This semester, UCB offered a Decal course on Strawberry Creek, participants who were targeted as one of the experimental groups).

Table 1: *Student Sample Groups*

	Control	**Decal**	**Direct Views of Stream**	**No Views of Stream**
# Samples	35	33	25	28
Description	A random control group of UC Berkeley students	Students with educational/institutional experience on Strawberry Creek	Students who presumably interact with the creek spontaneously by living by it	Students who live off campus but on an above ground portion of the creek
Where collected	On campus by Sproul Plaza and Dwinelle Plaza	On campus during the "Strawberry Creek Restoration Decal"	Off campus student residences in sight of the North Fork of Strawberry Creek: Tellefsen Hall (the Cal Band House) and Kingman Hall Student Co-op	Off campus Berkeley Student Co-op residences: Hoyt, Stebbins, Kidd House

Averages, modes, and weighted grand means (Table 2) were used to compare the individual sample groups with the entire sample, and the samples excluding the Decal students (as they are a specific experimental group and not very representative of the rest of the student body).

Table 2: *Averages, modes, and weighted grand means*

Average =	(n1+n2+n3)/total number in that specific stratum
Mode =	Most common answer, weighted
Grand Mean =	(w1*n1+w2*n2+...+wx*nx)/total number
n =	sample number
w =	Weight of that sample, calculated as (#in stratum/total number of samples)

Question #14, which asks students to draw a map of where they live relative to Strawberry Creek, was scored on a point system for clarity of their knowledge about geography, stream/watershed view and habitat (Table 3). See Appendix B for an example of responses to Question #14 that exemplify the scoring rubric. See Appendix C for random examples of student drawings responses to Question #14.

Table 3: *Scoring Rationale for Question #14*

Category	**How measured**	**Point Value**
Geography	If drawing puts creek in a relative geographic context to its surroundings	1
Stream/Watershed View	If drawing shows the North and South Fork, or entire watershed	1
Habitat	If drawing shows vegetation or other landscape features such as soil, rocks, trees, undergrounding, etc.	1

Overall, the questionnaire addressed our hypotheses as follows (Table 4):

Table 4: *Questionnaire Components*

Question #	**Content(s)**	**Hypothesis Addressed**
1, 2, 3	Student stream and river experiences prior to UC Berkeley	2
6	Student exposure to coursework, research	1
4, 5, 7, 8, 9	Student experiences specifically with Strawberry Creek	1, 2
10	Willingness to attend a restoration event on and off campus	1, 2
11	Reasons for participating in restoration events	2
12	Verbatim question from Purcell et al. 2007 ranking restoration values	
13	Views on who is responsible for managing Strawberry Creek	N/A
14	Draw your experience of Strawberry Creek	N/A

Results

Out of the 121 surveys completed, the four groups were represented as follows:

Table 5: *Survey Strata*

Strata	No. of participants
Decal	33
Control	35
Views	28
No Views	23
Total	**121**

Within the survey strata, the breakdown of students in their respective grade levels was as follows (Table 5):

Table 6: *Student Breakdown*

Grade Level	No. of participants
Freshman	25
Sophomore	23
Junior	28
Senior	22
5th Year	11
No response	12
Total	**121**

When asked to describe their prior experience with creeks (Question #1), 55 percent of all students cited examples of spontaneous use such as swimming, boating, or hiking. In contrast, 15 percent wrote down examples of institutional experiences like organized clean ups or class field trips. There was little difference between experimental groups in their answers to this question (Table 7):

Table 7: *Response to Question #1: "Describe your interactions with streams/rivers before attending UC Berkeley."*

Strata	Spontaneous (%)	Institutional (%)
Decal	48.0	9.0
Control	54.0	6.0
Views	57.0	18.0
No Views	6.0	32.0
Weighted Average	55.0	15.0
Weighted Average sans Decal	57.0	17.0

When asked specifically about their interactions with Strawberry Creek (Question #5), all students except for those in the Decal group reported significantly higher spontaneous interactions than institutional interactions (Appendix D). 20 percent of total students who lived on the creek (both View and No View groups) reported institutional interactions while only 6 percent of our Control group did. This is in contrast to the Decal group of which 73 percent reported institutional interactions. Both groups who live on the creek had a higher proportion of reported spontaneous use than either the Decal students or our Control group (Table 8):

Table 8: *Response to Question # 5: "Describe how you interact with Strawberry Creek."*

Strata	Spontaneous (%)	Institutional (%)
Decal	45.0	73.0
Control	37.0	6.0
Views	57.0	21.0
No Views	48.0	2.0
Weighted Average	46.0	31.0
Weighted Average sans Decal	47.0	15.0

Excluding the students in the Decal group, 20 percent of the Control group had taken a class where they learned about Strawberry Creek (Appendix D). This was slightly higher in students who lived on the creek, at 25 percent for those who have views and 32 percent for those who are without views (Table 9):

Table 9: *Response to Question #6: "Have you taken classes with field trips or research on Strawberry Creek?"*

Strata	% YES
Decal	100.0
Control	20.0
Views	25.0
No Views	32.0
Weighted Average	45.0
Weighted Average sans Decal	25.0

Overall, 24 percent of all students, excluding the Decal group, reported participating in a clean up event, but a larger proportion of students who live on the creek had participated in clean up than those in the Decal group (46% for those with views and 20% for those without views, versus 15 percent for students in the Decal group). In comparison, only 9 percent of the Control group had been involved in a Strawberry Creek clean-up. 13 to 16 percent of all students, excluding the Decal group, reported participating in lectures, research and field trips involving the creek. Only 1 percent or less reported participating in the Decal Course, the Annual Watershed Festival, or the Creek Walk with an informational pamphlet (Table 10):

Table 10: *Response to Question #7: "On Strawberry Creek, I have participated in (check all that apply):"*

	%	%	%	%	%	%	%	%
Strata	**Decal**	**Clean Up**	**Watershed Festival**	**Walk w/ Pamphlet**	**Lecture**	**Research**	**Field Trip**	**Other**
Decal	100.0	15.0	3.0	6.0	48.0	18.0	21.0	3.0
Control	0.0	9.0	0.0	0.0	11.0	14.0	9.0	6.0
Views	4.0	46.0	0.0	4.0	7.0	14.0	14.0	0.0
No Views	0.0	20.0	0.0	0.0	24.0	20.0	16.0	4.0
Weighted Average	28.0	21.0	1.0	2.0	23.0	17.0	15.0	3.0
Weighted Average sans Decal	1.0	24.0	0.0	1.0	14.0	16.0	13.0	3.0

When asked about their reasons for participating in a restoration event, 65 percent of students stated that it was their civic duty to do so (Appendix D). Coming in a close second was their environmental duty, at 59 percent. 64 percent of students with views of the creek reported that living by the creek was their motivation, but only 27 percent of the entire sample shared this opinion. Only Decal students reported that their grade was a driving force (67 percent), and 21 percent of the entire sample stated that a social event was their reason for participating in restoration (Table 11):

Table 11: *Response to Question #11: "What are your reasons for participating in restoration?"*

	%	%	%	%	%	%	%
Strata	**Live by Creek**	**Class Requirement**	**Civic Duty**	**Resume**	**Social Event**	**Environ. Duty**	**Other**
Decal	12.0	67.0	61.0	18.0	9.0	67.0	15.0
Control	9.0	0.0	66.0	9.0	17.0	60.0	6.0
Views	64.0	4.0	64.0	11.0	21.0	43.0	11.0
No Views	32.0	12.0	72.0	4.0	44.0	64.0	12.0
Weighted Average	27.0	21.0	65.0	11.0	21.0	59.0	11.0
Weighted Average sans Decal	33.0	5.0	67.0	8.0	26.0	56.0	9.0

When asked to draw a map of where they lived relative to Strawberry Creek, the Decal students scored the highest average of 1.58 out of 3 points. Students who have views of the creek came next at 1.18 points, followed by those who do not have views of the creek with a score of 1.09. Our Control group came last with a score of 0.71, resulting in a grand mean of 1.13 points including the Decal students, or 0.97 points excluding

them. Finally, students who have views of the creek scored higher for Habitat than the other four groups (Table 12):

Table 12: *Scored Response to Question #14: Draw a map of where you live relative to Strawberry Creek. Also draw a map of how you see Strawberry Creek."*

Strata	Geography	Stream/Watershed	Habitat	Sum
Decal	0.88	0.36	0.34	1.58
Control	0.57	0.11	0.03	0.71
Views	0.57	0.11	0.50	1.18
No Views	0.48	0.17	0.43	1.09
Weighted Average	0.64	0.19	0.31	1.13
Weighted Average sans Decal	0.54	0.13	0.29	0.97

In conclusion, most of the students sampled stated that they would attend a restoration event "1 time a semester" or "1 time a month", though there was a distinct difference between their willingness to attend an on-campus event versus an off-campus event. Overall, 97 percent of students stated a willingness to participate in an on-campus restoration event, while a smaller yet still substantial 75 percent indicated their willingness to participate in an off-campus restoration event in the future (Table 13):

Table 13: *Scored Response to Question # 10: I would attend a restoration event: On campus and/or off campus. Once a week, month, semester, year; Once in my time at Berkeley or Never."*

Strata	On Campus	Off Campus
Decal	31	24
Control	29	11
Views	23	25
No Views	22	16
Total	**105**	**76**

Discussion

Hypothesis 1: *Involvement in academic work, specifically courses and research, is the leading means of recruiting students for stream restoration work on the U.C. Berkeley campus*

The results support our first hypothesis. In summary, we found that 24 percent of students had participated in some form of organized clean up and 13 to 16 percent had experienced class lectures, research or field trips on Strawberry Creek (Table 8, Table 9). Within the questionnaires, students listed 21 different classes in a variety of departments when asked about their academic exposure to Strawberry Creek (Table 13):

Table 13: *Classes that mention Strawberry Creek*

Mentions	Department	Course(s)
19	Decal	Strawberry Creek Restoration Decal
11	Biology	BIO 1B: General Biology
9	Earth and Planetary Sciences	EPS 3: The Water Planet, EPS 50: The Planet Earth, EPS 80: Environmental Earth Sciences, EPS 117: Geomorphology
8	Environmental Science Policy and Management	ESPM 6: Environmental Biology, ESPM C10: Environmental Issues, ESPM C12: Introduction to Environmental Studies
4	Environmental Sciences	ES 10: Introduction to Environmental Sciences, ES 100: Introduction to Methods in Environmental Sciences, ES: Freshman Seminar
4	Landscape Architecture & Environmental Planning	LAEP 12: Environmental Science for Sustainable Development, LAEP 110: Ecological Analysis, LAEP 130: Sustainable Landscapes and Cities

1	Natural Resources	NAT RES 24: Freshman Seminar
1	Environmental Design	ED 11B: Introduction to Design
1	Integrative Biology	IB ? (Indecipherable course number)

This can be contrasted with the Strawberry Creek Walk pamphlet guide (which is geared to a wider audience that includes students), in which less than one percent of all students have participated. This confirms that campus efforts to engage and educate students have been successful, and also forces us to question whether the pamphlet walk, which facilitates valuable watershed experience (Charbonneau & Resh 1992), is an effective means of engaging students.

Though only one percent of students have participated in the Decal, those students reported higher involvement in restoration activities than the average student on campus (Tables 8, 9 & 10). More importantly, they were *more* willing to participate in future restoration events, both on and off campus (Table 12). This reinforces that academics are the most effective way of recruiting students for restoration work at UC Berkeley.

Hypothesis 2: *Prior exposure and residence proximity (i.e. spontaneous use) is a stronger indication of individual student enthusiasm than recruiting through academic work.*

Our results also led us to the conclusion that our second hypothesis was correct. In summary, more students who live on the creek and see it had participated in a clean up event than those actually in the restoration Decal (46 percent vs. 15 percent, respectively). Many of those students living on the creek indicated they were part of creek clean-up events hosted by their specific housing institution this fall.

Over 60 percent of all students sampled stated that their sense of civic or environmental duty was a driving factor in their motivation to restore streams. Since civic and environmental duties extend beyond campus, and beyond the years spent in college, this could mean that the sense of fulfillment these students feel from restoration will influence their future awareness or even career choices (Purcell et al 2007).

Though the on-campus efforts organized by UC Berkeley students and staff have resulted in many improvements to Strawberry Creek, only 15 percent of the Decal students reported having participated in the restoration of Strawberry Creek. This is in comparison to the 46 percent of students with views of the creek that have participated, and the 20 percent of those without views who also participated (Table 9). All of these proportions are higher than that of our control group (of which only 9 percent reported participation). This, along with the result that the Decal students ranked class credit equally to environmental duty, and slightly higher than civic duty, indicate that proximity and ownership are stronger catalysts for stewardship than the institutionalized exposure UC Berkeley offers (Table 10).

The fact that greater than 20 percent of our sample cited restoration as a social event, and 65 percent responded that it was their civic duty to participate, indicate that restoration is seen as both a way to build community and repay communal debts (Table 10). Simply getting students (or people) together to participate in a group activity can increase the flow of ideas and values, and enforce a sense of communal ownership, one of the essential aspects of stewardship (Riley 1998; Mozingo 2005; Hester 2006; Chanse &Yang 2005; Kondolf & Yang, 2008).

Conclusion

Students, though transient, remain an integral part of Strawberry Creek's future. Besides providing sources of research, labor and leadership (Purcell et. al 2007), students blur the distinctions between on and off campus by traversing between the two. Some students even live in residences with property on Strawberry Creek upstream of campus. This connectivity between on and off campus means the breadth of student engagement and education has potential implications for future management of Strawberry Creek. After all, Strawberry Creek, like all urban streams, knows no institutional or political boundaries (Charbonneau & Resh 1992). If the future of urban ecosystem management requires coordination across all scales (Svendsen & Campbell 2008), outreach, engagement, and stewardship are needed across these boundaries.

By expanding both educational programming and student research to include off campus portions of the stream, the campus community can embrace a watershed view for a better-integrated management of the Strawberry Creek Watershed. In the 1980's, educational pamphlets were sent to north-side residences on behalf of the City of Berkeley and the University, and stencils were placed on storm drains (Charbonneau & Resh 1992). Only continued outreach will ensure sustained awareness by these populations, especially if many of them are transient renters like students. Just as students have educated students on campus in the Strawberry Creek Restoration Decal, students can do the same off campus in their creek-side residences and non-creek-side residences alike. Collaboration between existing institutions like the Strawberry Creek Restoration Project and classes on campus with off campus institutions like the residences of the Berkeley Student Cooperative, would benefit both students and the existing campus creek

management. Urban creek restoration may be more of a social project than an ecological one, and collaborative planning is "beneficial not just for consent, but (for) long term invisible outcomes in terms of collective learning and accumulation of social, political and economic capitals" (Kondolf & Yang 2008).

Given the proliferation of local nonprofit urban creek stewardship groups, and the Berkeley Watershed Management Plan proposal (Bradt 2011), the opportunity for collaborative watershed-scale stewardship of Strawberry Creek has arrived. If "the development of collaborations allowing participants to engage with local projects… tends to complement the quest for technical solutions" (Chanse 2011), University of California Berkeley is especially poised to contribute technical as well as collaborative solutions for issues facing urbanized watersheds. The success of urban creek management on University of California Berkeley campus can guide the future management of not only the entire Strawberry Creek Watershed, but also other similarly affected urban watersheds in the region. Student stewards can provide the link between academic solutions and collaborative engagement with urban creeks.

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