Wildlife CSI (Compost Scene Investigation):
Engaging Students in a Large Introductory Biology Course through Citizen Science

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Background and Objectives

Citizen science is an emerging approach recognizing that members of the public can join professional scientists to make contributions to actual research projects (Dickinson and Bonney 2012). Such collaborative efforts can address questions on much larger scales than possible for researchers working independently. The citizen scientists receive the satisfaction of participating in real research, as well as educational and potentially other benefits (Shirk et al. 2012). Some examples of citizen science include, the Cornell Lab of Ornithology's *Project Feeder Watch* in which volunteers use standard procedures to record winter bird numbers at their bird feeders and Zooniverse's *Galaxy Zoo* in which participants via the Internet categorize the shape of galaxies in images captured by the Hubble Telescope. Citizen scientists involved in these projects, respectively, have demonstrated population trends for North American birds on a continent-wide scale and have even discovered new galaxies.

The influence of human activity on the ecology of scavenging wildlife is a focus within my lab. Specifically we are studying how residential composting affects these animals' behavior. Wildlife monitoring cameras record visitation to our compost piles, capturing hundreds of thousands of images. Faced with the daunting task of analyzing the content of these images, we have turned to citizen science. Working with colleagues (J.-P. Haeberly, D. Tatem, C. Jirowitz, K. Patashnick) in IT at Trinity, we have developed an citizen science program, Wildlife CSI (Compost Scene Investigation). The program's array of on-line resources are accessible via our portal (scavengers.trincoll.edu) to allow Internet-based participants to take part in this research through crowdsourcing. My aim as a CTL Fellow during the 2013-14 academic year was to use Wildlife CSI to increase student engagement in our introductory biology course, BIOL 182 (*The Evolution of Life*), by incorporating this citizen science project and linking it to the ecological concepts that we explored in the course during the Fall 2013 semester.

Nature of the BIOL 182

BIOL 182 is one of the largest courses at Trinity, averaging over 120 students per class during its last seven offerings (2008-2013). The lecture course is team-taught by four faculty. I typically contribute its coverage of ecology. Additionally, each student enrolls in an accompanying laboratory section. With such a large enrollment, engaging students in lecture is a major challenge. Although the Biology Department has made some inroads on this front (e.g., splitting the lecture into two sections, as of Fall 2010, and use of clickers to provide instantaneous feedback based on student responses to questions in lecture), nonetheless there is room for improvement.

Integration of Wildlife CSI into BIOL 182

Although my coverage of ecology represented the final quarter of the semester (15 November to 8 December 2013), student involvement in Wildlife CSI, began in mid-October over Trinity Days, with a webinar that introduced the overall project and the various on-line citizen science tools that the students would use. The webinar was offered on three occasions, and each student was required to participate in one. This prepared them to use the Field Guide to learn to identify the

33 species of birds and mammals documented to date at the piles. Once they passed the qualifying quiz, they were able to contribute image identification to our database.

The students were organized onto seven teams, each corresponding to their laboratory section. The teams contended in a friendly competition during the seven-week period until the end of the semester. The team accruing the highest contribution value, a reflection of the number of accurately identified images (based on the previously established relationship between agreement levels between five independent viewings of a given image and the accuracy of its categorization), was the winner (Table 1). Students were expected to contribute at a baseline rate of 60 images/week, leading to 4% of their overall course grade. At the close, the BIOL 182 students had made an impressive 111,660 image categorizations (averaging, 754/person, well above the baseline level). The winning team was treated to a pizza dinner, with homemade ice cream and an entertaining video on raccoon ecology. The agreement level and actual accuracy rate for the BIOL 182 participants will be determined this summer. Additionally, students completed an environmental psychology survey both before and after their engagement with the project.

Table 1. CSI Fall 2013 Team Final Standings, Report 7 – 12/09/13

Team Name	Average # Images Reviewed per Member	Contribution Value
Trinvestigators (T 1:30)	1065	893
Funguys (W 6:30)	980	834
SCU – Special Compost Unit (R 1:30)	761	623
Plantams (R 6:30)	640	537
Early Birds (R 9:25)	604	508
Galloping Gallus (T 9:25)	533	439
CSX2 (W 1:15)	488	414

During their involvement in Wildlife CSI, students used the project's social network. In addition to conveying logistical information, answering student questions, and posting team standings, the network enriched participants' educational experience by providing media coverage of studies and other material conceptually related to the project. Content may be viewed on the Wildlife CSI blog (http://commons.trincoll.edu/csi/) or its parallel Facebook site (http://www.facebook.com/groups/213946485413668/). The social network was particularly important prior to my appearance in the BIOL 182 in mid-November, at which time the elements it covered were more directly incorporated into the classroom experience.

One goal of my CTL Fellowship was to develop ways to use the students' citizen science experience and enthusiasm as a springboard from which to connect to the concepts that I cover in the course. To do this I developed a number of case studies, each relevant to the students' CSI experience and each illuminating a fundamental ecological concept. For example, a surge in human deaths to rabies in the India in the 1990s is understandable when one realizes that during this period the primary native scavengers, vultures, experienced a drastic population decline, thus freeing from competition, feral dogs, which spread the disease.

Effect of Wildlife CSI on Student Performance in BIOL 182

In general, BIOL 182 students were quite enthusiastic about Wildlife CSI, as reflected by the following sample of responses to the course evaluation's prompt of "I liked the CSI activity because…"

- It felt cool to participate in research! Plus I liked looking at all the animals, and now when I'm at home (I live in NH) I can identify animals I see.
- It provided me with a great example where I could see why ecology has importance within the world. Many concepts that were learned through CSI were then applicable to the class material.
- Real world applications such as CSI always help me get engaged with the material, and it was an enjoyable activity itself.
- It is an easy way to raise your grade in the class. It's a game.
- It brought me back to nature, which really helps my stress and happiness level. I am an avid outdoors-lover and it is hard to stay grounded in the Trinity community. CSI helps me do that, and it makes me feel like I am doing meaningful work.

Reponses to the course evaluation's prompt of "I didn't like the CSI activity because…" illustrate that the tedium and repetition inherent to actual research were a common complaint:

- It was tedious.
- It was rather repetitive. Many of the pictures were crows. Crows are only so interesting.
- I would sometimes forget to complete it for the week.
- I am competitive and my team lost.
- I didn't like it because I find no point in the CSI activities.

To see whether the addition of Wildlife CSI may have influenced the performance of students in BIOL 182 during the Fall 2013 semester, exam scores were compared to those from Fall 2011, when I last taught in the course, but without using the citizen science program. The results are consistent with a positive learning effect of Wildlife CSI, but are inconclusive (Fig. 1): student performance in 2013 did improve on Exam 5 (ecology), but it also did so for Exam 2 (plant biology), while it did not change for Exam 1 (animal physiology).

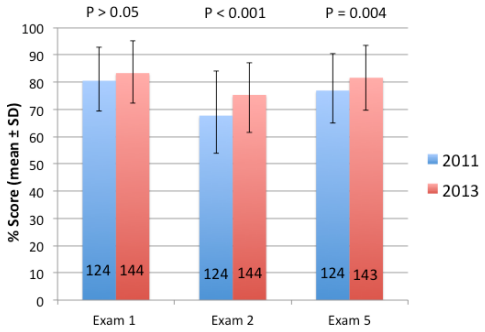

Figure 1. Comparison of BIOL 182 student exam performances in 2013 (with Wildlife CSI) and in 2011 (without it). Exam 5 represents the ecological coverage. Exams 1 and 2 represent animal physiology and plant biology, respectively. For a given exam, the same instructor taught during the two years. This, however, was not true for Exams 3 & 4, which are therefore not included. P-values from Mann-Whitney U test are provided above respective column pairs, while sample sizes are presented at column base.

Based on the success of Wildlife CSI, I will again employ it in Fall 2014.

Literature Cited

Dickinson, J.L. & R. Bonney. 2012. *Citizen Science: Public Participation in Environmental Research.* Cornell University Press.

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