**Ecological Citizen Science: Engagement of Students in a Large Introductory Biology Course**
**A Proposal for the CTL Fellows Program, by Scott Smedley, Biology – 25 March 2013**

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 practices affect 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, K. Patashnick) in IT at Trinity, we have developed an array of on-line resources (accessible via our portal: scavengers.trincoll.edu) to allow Internet-based participants to take part in this research through crowdsourcing. I here propose 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 explore in the course.

BIOL 182 is one of the largest courses at Trinity, averaging nearly 120 students per class during its most recent six offerings (Fig. 1). 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 substantial room for improvement.

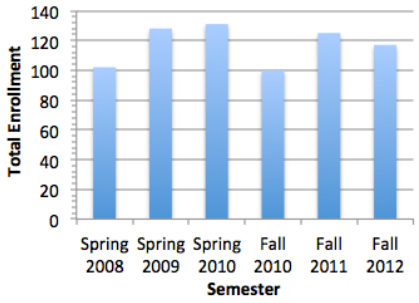

Fig 1. Total enrollment in the past six offerings of BIOL 182.

I intend to use our citizen science venture to engage BIOL 182 students this fall. This will capitalize upon new features that we have developed over the past six months and which we are currently pilot testing in two courses (M. O'Donnell's *Urban Wildlife Ecology* and C. Swart's *Animal Behavior*). These features engage the students by adding an element of gaming to the citizen science, thus permitting some friendly competition among individuals and teams, as they strive to accurately identify and count wildlife in images from our experiment.

Participation in the project is completely on-line. After studying our field guide to learn how to identify the various species of compost visitors, participants take a qualifying quiz to demonstrate their competency. Upon passing the quiz, they can contribute to the actual research. The database serves each image to five independent viewers who categorize their wildlife content. If ≥80% of these viewers agree on the classification of an image, we accept their assessment. In our initial pilot study with an audience of primarily high school students, this agreement threshold was reached or exceeded for 86% of the images. For these "agreed upon" images, the high

school citizen scientists' categorization was 94% accurate, when compared to benchmark categorizations determined in our lab.

Drawing upon experience gained from the two pilot studies, as a CTL Fellow, I would implement the first thorough integration of our ecological citizen science project into the conceptual fabric of a course. I have a fairly good idea how to accomplish this mechanistically, but I must contemplate how to most effectively connect it to the subject matter to achieve the best pedagogical outcome.

Logistically, once the BIOL 182 enrollment stabilizes with the close of the Add/Drop period next fall, each student will create a user profile and teams will be formed (likely based on lab groups). During that week, background on the project's conceptual basis and use of its on-line resources will be presented via a webinar (since some teams will likely originate from Trent University in Ontario; see connection below). Each BIOL 182 student will participate in one of several sessions of the webinar. Following this, they will study the Field Guide and take the qualifying quiz (on average 3 attempts are required to pass). Then during the third week of the semester they will start to contribute to the database. The baseline contribution rate will be 60 images/week. From our pilot this semester, this seems a reasonable level. If students wish to contribute beyond that level, additional accurately identified images will advance their team's standing in the contest. Participation will continue through the end of the semester. Throughout, students can benefit from the project's social network. In addition to conveying logistical information, answering student questions, and posting team standings, the network enriches participants' educational experience by providing media coverage of studies and other material conceptually related to the project. Content on the group site for this semester's pilot can be seen at http://www.facebook.com/groups/213946485413668/ (once access is requested). At the end of the semester, the teams with the highest contribution scores will receive prizes. For individuals, the database record of their contribution value would determine their grade for this component of the course, representing ca. 4% of their overall grade. This citizen science project has Trinity IRB approval.

My coverage of ecology in BIOL 182 occurs during the final quarter of the semester. I will use the CTL Fellowship to develop ways to use the students' citizen science experience as a steppingstone from which to make relevant connections to the concepts that I cover in the course. For example, the role of scavengers would link nicely to trophic relationships in ecological communities. Composting has ties to nutrient cycling and decomposition. I will aim to forge connections such as these into an engaging, cohesive presentation of introductory ecology.

Beyond the impact of more deeply engaged students – better learners, this new feature to BIOL 182, will aid my application of citizen science in other contexts of my teaching. For example, I am considering submitting a National Science Foundation (NSF) proposal focusing on the integration of citizen science into undergraduate curricula. Furthermore, I currently have an NSF submission that aims to involve returning veterans in our ecological research via citizen science. Associated with their military experience, these people often have exceptionally well-developed observational skills. This is valuable since many of our images involve rather cryptic wildlife. I am collaborating with Dr. Elizabeth Nisbet, a Trent University environmental psychologist who has developed the Nature Relatedness Scale (Nisbet et al. 2009, 2011), a measure of individuals' connection to the natural world, to determine whether participation in our ecological research could influence returning veterans ties to nature and their psychological well being.

I intend to present this linkage of citizen science to introductory biology as a workshop through the Association of Biological Laboratory Education, as I did with my earlier pedagogical work supported by Trinity's CTL in 2009. That earlier work was recently published (Smedley 2012).

## Literature Cited

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