CITIZEN SCIENCE:
THEORY AND PRACTICE

Looking More Carefully: A Successful Bioblitz Orientation Activity at an Urban Public University

CASE STUDIES

]u[ubiquity press

MEGAN ROKOP
RAJINI SRIKANTH
MARC ALBERT
CATHERINE RADONIC
RACHEL VINCENT
ROBERT STEVENSON

Author affiliations can be found in the back matter of this article

ABSTRACT

A college freshman orientation activity incorporating citizen science was designed and implemented by a partnership between the University of Massachusetts Boston and the National Park Service. The goals of this study were to create an engaging citizen science experience for first-year college students who did not have prior background in the field, and to iterate and improve the activity (three consecutive summers, 2017–2019) so as to generate insights that may improve future citizen science projects. Over three years, students (468 total) largely unfamiliar with citizen science (92.6%) or iNaturalist (97.9% first-time users) employed the iNaturalist app to document the biodiversity of Thompson Island in Boston Harbor. Student outcomes were assessed using pre- and post-surveys, and survey data indicated that the bioblitz effectively engaged these students: More than 60% of students found the activity very or extremely engaging, and less than 1% found it not engaging. More than 70% of the students indicated they were somewhat, very, or extremely interested in learning about or participating in citizen science, and in returning to the Boston Harbor Islands, in the future. A similar percent also believed their data were somewhat, very, or extremely important to the islands and to the National Park Service. The students' self-reported level of engagement and interest shows how a fruitful campus-community collaboration can excite students from across majors in a citizen science project. The three iterations of this activity allowed us to make changes over time and gain insights that may be helpful to the design of future citizen science projects.

CORRESPONDING AUTHOR:
Megan Rokop
University of Massachusetts Boston, US
megan.rokop@umb.edu

KEYWORDS:
citizen science; biodiversity; urban ecology; undergraduate student education; iNaturalist; National Park Service community partnership

TO CITE THIS ARTICLE:
Rokop, M, Srikanth, R, Albert, M, Radonic, C, Vincent, R, Stevenson, R. 2022. Looking More Carefully: A Successful Bioblitz Orientation Activity at an Urban Public University. *Citizen Science: Theory and Practice,* 7(1): 1, pp. 1–12. DOI: *https://doi.org/10.5334/cstp.451*

INTRODUCTION

Citizen Science actively engages non-specialist members of the general public in science projects around the world (Cohn 2008; Dickinson et al. 2010; Gura 2013). These projects can be appealing and educational for the participants and can produce useful scientific data for the scientists organizing or partnering on these projects (Bonney et al. 2009; Raddick et al. 2009; Bonney et al. 2016). Oftentimes, citizen science projects engage participants in tracking the species living in a certain place over time (Bonney et al. 2009). Citizen science projects can be designed for adult volunteers, but can also be designed to effectively engage K–12 students (Dickinson and Bonney 2012; Harlin et al. 2018). In this study, we explore the value of a single-day biodiversity documentation citizen science project focused in a well defined area (a bioblitz) with rising first-year students entering the Honors College at the University of Massachusetts Boston (see the recent special issue of CSTP devoted to higher education for other examples).

The majority of Honors Colleges or Honors Programs in the United States stress interdisciplinarity as a core value—that is, helping students understand that most of the challenges we face as humankind can be most effectively addressed by drawing on the insights of multiple disciplines (NCHC 2013). We seek to train our students to think in complex analytical ways and to recognize that any situation is the result of the intersection of and interaction among multiple forces: historical, political, economic, social, environmental, and cultural. Interdisciplinary approaches to understanding one's world undergird the pedagogical practice of place-based learning or place-as-text that is adopted by most practitioners of honors education.

This idea of place-based learning is central to the Thompson Island trip that the UMass Boston Honors College holds as our freshman student orientation. UMass Boston is on the Boston Harbor and thus Thompson Island (one of the Boston Harbor Islands) is just a short thirty-minute boat ride from campus. The curriculum for this Thompson Island trip draws on the National Collegiate Honors Council's trademarked City as Text™ (CAT) or place-as-text approach (Braid 2000), which "refers to structured explorations of environments and ecosystems designed as on-going laboratories through which small teams investigate contested areas and issues in urban environments, or competing forces in natural ones" (NCHC Place as Text Committee 2012). Place-based learning has many adherents and a rich body of literature developed over many decades of practice. Such pedagogy emphasizes the local, values relationships between natural resources and humans, and acknowledges the impact on natural resources of social interactions among those who live in a particular place (Gosselin et al 2016).

Thompson Island is part of the Boston Harbor Islands National and State Park, is owned by Thompson Island Outward Bound Education Center, and is managed in partnership with the Massachusetts Department of Conservation and Recreation (DCR) and the National Park Service (NPS). The island was created by ancient sedimentary and metamorphic rock topped by a surface layer deposited and sculpted by glaciers, and is part of a drumlin archipelago created when glacial ice melted and left behind the current harbor and the islands (Thornberry-Ehrlich 2017). The first human inhabitants were Native Americans who made their seasonal homes on the islands for thousands of years; some of the oldest Native American archeological sites in the region are from the Boston Harbor area. The Massachusett tribe inhabited the area that includes Boston Harbor. Many Massachusett, along with other Native Americans, including Nipmuc and Wampanoag, were forcibly incarcerated on at least three Boston Harbor islands during King Phillips War in the winter of 1675–1676, in the first relocation of Native people in North America (Cultural Survival 2019). Today, Thompson Island provides diverse natural habitats (beach, rocky shoreline, salt marsh, meadows, and forests) set amongst a built campus that has been in continuous educational use for more than 170 years and thus offers teachers several types of field labs for instruction.

In this paper, we describe a campus-community partnership between the UMass Boston Honors College and the NPS, through which we designed a bioblitz citizen science activity on Thompson Island and implemented it in three later summer programs from 2017 through 2019. Students in the UMass Boston Honors College were guided by NPS staff on a half-day experience in which they documented the species they observed living on Thompson Island, using the iNaturalist app on their smartphones. Student pre-survey and post-survey data were obtained to address our first main study goal of creating a citizen science activity that was engaging for our college students, which we measured using a series of questions that asked the students: how engaging and interesting they found the activity, how interested they would be in learning about or participating in citizen science projects in the future, how interested they would be in returning to the Boston Harbor Islands, and how important they felt their work was to the islands and to the NPS. Using the iNaturalist data obtained for each session, we characterize the team formation and data collection effort made by the students. During the course of the projects, both within and across three years, discussions among UMass Boston Honors College and NPS staff led to revised practices for instruction and implementation. This iteration and improvement allowed us to address our second main goal for this study, namely to gain insights from our own work that may be valuable to future groups organizing citizen science projects. In another study (Stevenson et al, in press), our collaborators have investigated the data quality of the iNaturalist observations, and found that our students are making useful contributions to understanding the biodiversity of the island, showing that the activity we designed can serve as an authentic scientific biodiversity documentation activity useful to park managers and scientists.

METHODS

PROJECT DESIGN

The two goals of this study were to: 1) create an engaging citizen science activity for incoming college first-year students during their orientation trip, and 2) to iterate and improve this activity over the course of several years, to gain insights into implementing future citizen science projects with similar purposes and/or participants. We implemented this activity during the UMass Boston Honors College freshman orientation trip. Honors College first-year students entering UMass Boston are invited to attend a 2-day retreat at the Outward Bound Education Center on Thompson Island in the Boston Harbor Islands. The vast majority of incoming students choose to attend this trip, which is funded by the college and thus is at no expense to the students. This trip is designed in part to give students a chance to meet their fellow students and to start to make friends, and the overnight element of this trip gives the students ample time to build community with their new college classmates. The trip is also designed to engage students in the process of becoming interdisciplinary scholars through several activities that occur across the two days. An additional intention of the trip is to cultivate an appreciation for the Boston Harbor Islands given the immediate proximity to the campus. We designed a bioblitz to be the most time-intensive activity the students do on this orientation trip, because a bioblitz fits well with the purposes of the trip: to build student community, to engage students as interdisciplinary scholars, and to build appreciation for the Harbor Islands. The bioblitz was undertaken in partnership with the NPS which runs educational programs on the island for visitors and school groups, including bioblitzes that utilize the iNaturalist platform and mobile app.

THE STUDENTS

In this study, we worked with students from UMass Boston, which is the most diverse school in New England (UMass Boston Office of Communications 2020). At UMass Boston, 66% are first-generation college students, 41% are Pell Grant recipients, and 58% speak a language other than English at home. Many of our students (48%) are from the city of Boston or nearby urban areas. In the UMass Boston student body, 54% of students are students of color (18% black or African American, 18% Hispanic/Latino, 3% two or more races, 15% Asian American), and 46% of students are white. The UMass Boston Honors College student body is representative of the student body at the university overall. Currently in the Honors College, 62% of Honors students are students of color (11% black or African American, 22% Hispanic/Latino, 5% two or more races, 24% Asian American).

Out of 725 students in the Honors College, only 240 are life science majors (specifically, majors in biology, biochemistry, chemistry, and environmental science). The remaining students come from other colleges across the university, including the College of Management, the College of Liberal Arts, the College of Education and Human Development, and the College of Nursing and Health Sciences. Thus, our citizen science activity engaged a group of students whose most common majors include Management, Psychology, Computer Science, Nursing, and Biology.

IMPLEMENTATION AND STRUCTURE OF THE ACTIVITY

Prior to the activity, students completed NPS Volunteers-In-Parks agreements, and a written pre-survey. Students were given ~30 minutes of training before embarking on two hours of exploration of Thompson Island with a small set of supplies to temporarily capture or contain any insects or marine organisms. The ~30 minutes of training included an introductory Prezi presentation by NPS staff (which focused on how to use iNaturalist to make observations of organisms living on Thompson Island), followed by a field tutorial on photographic techniques. The content of this presentation is discussed in more detail in the section entitled Introductory Training Presentation, below.

Students completed the activity in batches of roughly ~48 students at a time. That group was then split into four sets of ~12, and each set of students explored one quadrant of Thompson Island together along with a NPS staff member as a guide. Students were provided with maps that divided the island into four quadrants, chosen because they were of roughly equal size and each contained a diversity of habitat types. Students took photos using the iNaturalist app on their smartphones. All students returned at the end for 15 minutes of reflection, to fill out the post-survey and to share each student's favorite observation, in small groups with a National Park Service staff member as a facilitator.

In 2018 and 2019, several factors were implemented that were not included during the initial year (2017).

These factors were incorporated on the basis of a detailed discussion of what worked well and of what could have worked better after the first iteration of the activity. After the 2017 iteration, the staff and faculty at UMass Boston and the NPS brainstormed tactics that might increase student engagement and motivation, and thereby also increase the quality of the iNaturalist observations generated by the students, such that the observations were more likely to be identified by iNaturalist users.

First, the introductory presentation was adjusted (see below for more detail) to give students more directed advice on what they can do while in the field to generate high-quality iNaturalist observations. Second, incentives (prizes) were provided to motivate the students to take a higher number of observations, and photos of higher quality. Third, the students were provided with macro lenses, to use for magnification of the organisms during the imaging process. Fourth, a ranger would "pool" four student teams (roughly 2–3 students each) into a pack of roughly 8–12 students who walked around the island together with the ranger (whereas in 2017, each team of 2–3 students walked around the island separately and mostly without an NPS guide present). Fifth, all students were encouraged to take photos of all types of organisms in an effort to encourage the students to capture images of any organisms that most excited them (whereas in 2017, each group was asked to focus on only one type of organism: either insects, fungi, plants, or marine life). Sixth, students were given the choice to return from the field early, to spend ~30 minutes with an NPS guide working to identify some of their observations, using iNaturalist along with field guides of organisms common to the Boston Harbor Islands. The reasons for these changes, and their implications on instruction, are presented in the Discussion.

INATURALIST APP

Prior to the trip, students received an email asking them to download the most current version of the iNaturalist app onto their smartphones, and asking if they would be willing to use their smartphone during a small group activity during the island trip. Each student was asked to create an account if they were so willing. Student teams of roughly 2–3 students were formed, such that at least one team member had a smartphone with the iNaturalist app downloaded, and with an account created. NPS staff created an iNaturalist Project in which all student observations were entered from that year (*2017 UMass Boston Honors College BioBlitz*, *2018 UMass Boston Honors College BioBlitz*, *2019 UMass Boston Honors College BioBlitz*). Students used the iNaturalist app to take geo-referenced photos and add notes, thereby creating observations. Students could then either attempt to identify the species or the class of species (for example, Mollusk or Plant) in each of their observations or leave it as unknown. Students later had the opportunity to watch as their observations were identified over time by members of the iNaturalist worldwide community (*www.inaturalist.org*).

Each year, students had the option of multiple trip dates. On each individual trip date, students were broken up randomly into two groups, one who did the citizen science activity in the morning, and the other who did the activity in the afternoon. A total of 468 students completed the surveys over the three years (2017: three trips for 227 students total; 2018: two trips for 113 students total; 2019: two trips for 128 students total)—resulting in 14 different training sessions (two per trip, morning and afternoon). (No significant differences were seen between results from the morning and afternoon groups [data not shown].)

INTRODUCTORY TRAINING PRESENTATION

After taking the pre-survey, students received ~30 minutes of training before heading into the field. This training consisted of a short Prezi presentation that engaged the students in key concepts and skills important for the activity. The presentation began by highlighting how citizen science empowers members of the general public from around the globe to engage in active science research and in community projects. A short video showed screen captures of what it looks like to make an observation in iNaturalist.

In the second and third years (2018 and 2019), additional components were added to the introductory presentation. Data were displayed regarding how many observations were made by UMass Boston students the year before, how many members of the iNaturalist community helped identify species from photos taken over the past year, and how many identifications were confirmed and thus deemed Research Grade. Examples of high-quality observations were presented, to reiterate the point that having multiple photos from multiple angles and perspectives made the observation most useful for identification. Also, examples of individual high-quality photos were shown, and compared with photos that are less useful for purposes of identification. Examples of photos were also shown to demonstrate what a big difference macro lenses can make in magnifying images taken via smartphones. Examples were also provided of useful notes inserted into the observation along with the photographs, in order to aid with identification. As a final preparation of independent exploration, when first heading out into the field, NPS facilitators requested that each student collect one test observation to make sure that they were correctly using the iNaturalist app.

IMPLEMENTING PRE- AND POST-SURVEYS

Students completed a written paper-and-pencil pre-survey immediately before the training began. The pre-surveys were taken before any aspect of the activity was provided, so students had no insight into what the activity was, or what the goals were. Immediately following the activity, students completed a written paper-and-pencil post-survey. Each student was given a randomly assigned numerical code, so that pre- and post-survey data for each student could be linked (while masking identity in the analysis). Survey data were entered into Excel for data storage and analysis.

WORDING OF PRE- AND POST-SURVEY QUESTIONS

The pre-survey questions were designed to measure how much experience the students had coming in, with citizen science, nature, iNaturalist, and the Boston Harbor Islands. The pre-survey questions used the following wording (with options for multiple choice shown after each question):

- Before this trip, had you ever heard of the term "citizen science"? (yes/no)
    - If yes: Before this trip, had you ever engaged in a citizen science project? (yes/no)
- How much time would you say that you have spent in nature (e.g., camping, hiking, etc.) over the last few years? (none/ very little/some/a lot/tons)
- How much experience do you have taking photos of wildlife (e.g. plants, animals, etc.)? (none/ very little/ some/a lot/tons)
- Before this trip, had you ever used the smartphone app "iNaturalist"? (no/yes)
- Before this trip, how many times have you visited the Boston Harbor Islands? (never, 1, 2, 3, 4+)
- How excited are you to take part today in a session involving doing a citizen science project on the Boston Harbor Islands? (not at all/very little/somewhat/very/ extremely).

The post-survey questions were designed to measure levels of student engagement by asking students if they found the activity interesting and engaging, if they would like to return to the islands or learn more about citizen science in the future, and if they considered the work that they did to be important. The post-survey questions used the following wording (with options for multiple choice shown after each question):

- How engaging and interesting did you find today's session? (not at all/very little/somewhat/very/ extremely)
- How educational did you find today's session—i.e., how much do you feel you learned? (nothing/very little/ some/a lot/tons)
- How confident do you feel that you can take photos of wildlife that could be useful to a citizen science project? (not at all/very little/somewhat/very/extremely)
- After today's session, how interested would you be in returning to the Boston Harbor Islands in the future? (not at all/very little/somewhat/very/extremely)
- After today's session, how interested would you be in learning more about—and/or engaging in—a citizen science project in the future? (not at all/very little/ somewhat/very/extremely)
- How useful did you find the introduction provided to you by the instructors before you went out today to gather data? (not useful/a little useful/somewhat useful/very useful/extremely useful)
- How did you find the balance in this session, between the time spent in the introduction with the instructors, and the time spent gathering data? ("I like how the time was balanced between the introduction and gathering data"/"I would have preferred that we spent more time on the introduction, and less time gathering data"/"I would have preferred that we spent less time on the introduction, and more time gathering data")
- How important do you feel the citizen science work you did today was to the NPS and for the Boston Harbor Islands? (not at all/very little/somewhat/very/ extremely)
- Which quadrant of the island did you explore today? (One, Two, Three, Four).

ANALYSIS OF THE OBSERVATIONAL EFFORT

Data about iNaturalist observations from each project year were obtained using the rinat library (*https://github.com/ropensci/rinat*) and analyzed in R using RStudioR (R Core Team, 2020), RStudio (RStudio Team 2020).

RESULTS

PRE-SURVEY RESULTS: STUDENTS' LEVEL OF BACKGROUND KNOWLEDGE AND EXPERIENCE

Survey results were quite consistent across the three years of the orientation trip, and are thus pooled together in this analysis, with a total n = 468. The pre-survey results revealed that students were unfamiliar with citizen science; 92.1% answered "no" when asked if they had ever heard the term "citizen science." Almost no one had used the iNaturalist app previously; 97.9% answered "no" when asked if they had ever used iNaturalist. Thus this activity was completely novel for all but 10 of the 468 students involved in the project.

Furthermore, few of the students had ever visited the Boston Harbor Islands before. Notably, 65.4% of students had never visited the islands, and the next most common answer was that they had visited once (13.7% of students). Only a small proportion of students had visited two times (11.0%), three times (4.9%), or four or more times (5.1%).

The students had also not spent much time in nature; when asked how much time they had spent in nature over the past few years, only 27.3% answered "a lot" or "tons" (***Table 1***). The most common answer was "some" (41.9%). They also had limited experience with photographing wildlife, with only 11.1% answering that they had "a lot" or "tons" of experience taking photographs of wildlife, with the most common answer being "very little" (39.7%).

Students also seemed hesitant about the upcoming activity. When asked how excited they were to "take part today in a session involving doing a citizen science project on the Boston Harbor Islands," the majority (59.6%) answered "somewhat." The responses to this question showed a small proportion of students feeling strongly one way or the other: 3.6% answered "not at all"; 11.5% "very little"; 59.6% "somewhat"; 19.4% "very"; and only 5.8% "extremely."

POST-SURVEY RESULTS: STUDENTS' LEVEL OF ENGAGEMENT IN THE ACTIVITY

Despite the hesitancy before the activity, the post-survey analysis revealed that the students had an overall positive experience during the exercise, with some extremely positive (***Table 2***). This range of enthusiasm was reflected in the number of observations teams made, which varied from between 1 observation to more than 20 during the two-hour period in the field (***Figure 1***).

When asked "How engaging and interesting did you find today's session?", a sizeable majority of students (62.1%) answered either "very" or "extremely" (***Table 2***), and about a third of students (30.7%) said they would either be "very" or "extremely" interested "in learning about and/or engaging in a citizen science project in the future." A sizeable proportion of students also reported interest in the park following the activity, as 43.1% of students said

	HOW MUCH TIME WOULD YOU SAY THAT YOU HAVE SPENT IN NATURE (E.G., CAMPING, HIKING, ETC) OVER THE LAST FEW YEARS?	HOW MUCH EXPERIENCE DO YOU HAVE TAKING PHOTOS OF WILDLIFE (E.G., PLANTS, ANIMALS, ETC)?
None	6.00%	12.00%
Very little	24.80%	39.70%
Some	41.90%	37.30%
A lot	22.00%	9.60%
Tons	5.30%	1.50%

Table 1 Pre-survey results: Most students had some or very little prior experience with nature.

	HOW ENGAGING AND INTERESTING DID YOU FIND TODAY'S SESSION?	AFTER TODAY'S SESSION, HOW INTERESTED WOULD YOU BE IN RETURNING TO THE BOSTON HARBOR ISLANDS IN THE FUTURE?	AFTER TODAYS' SESSION, HOW INTERESTED WOULD YOU BE IN LEARNING MORE ABOUT &/OR ENGAGING IN A CITIZEN SCIENCE PROJECT IN THE FUTURE?	HOW IMPORTANT DO YOU FEEL THE CITIZEN SCIENCE WORK YOU DID TODAY WAS TO THE NPS AND FOR THE BOSTON HARBOR ISLANDS?
Not answered	1.10%	1.10%	1.10%	3.40%
Not at all	0.60%	4.30%	4.30%	3.00%
Very little	3.60%	10.20%	16.50%	14.30%
Somewhat	32.50%	41.20%	47.40%	45.30%
Very	48.90%	31.60%	25.40%	26.20%
Extremely	13.20%	11.50%	5.30%	7.70%

Table 2 Post-survey results: Most students were very or extremely engaged overall (first column), and somewhat or very engaged in more specific aspects of the activity (second to fourth columns). Less than 5% were very little or not at all engaged overall, and 14.5 to 20.8% were very little or not at all in more specific aspects of the activity (second to fourth columns).
Note: NPS: National Park Service.

they would be either "very" or "extremely" interested in "returning to the Boston Harbor Islands in the future." (*Table 2*).

Notably, many students perceived that their work was important, in addition to finding the work engaging. When asked "How important do you feel the citizen science work you did today was to the NPS and for the Boston Harbor Islands?", 33.9% of students answered either "very" or "extremely" (*Table 2*).

POST-SURVEY RESULTS: STUDENTS' LEVEL OF LEARNING FROM THE ACTIVITY

Along with the overall high levels of engagement in the activity, there was an overall positive response (but again, a range of opinions) to questions about how much students learned, their confidence in the scientific value of their photographs, and the values of their contribution to the National Park Service (*Table 3*).

A sizeable proportion of students (44.2%) felt the session was very or extremely educational. Notably, students felt they had learned so much from the activity, that they were confident that their photos could be useful to a citizen science project, with 61.6% of students reporting that they felt they were "very" or "extremely" confident that they can take photos that would be useful (*Table 3*).

The introductory presentation was very well received (*Table 3*). A solid majority of students (68.4%) found the presentation to be either "very" or "extremely" useful. We also seemed to strike a good balance in the amount of time spent doing the introductory presentation versus time in the field. When we asked students "How did you find the balance in this session, between the time spent in

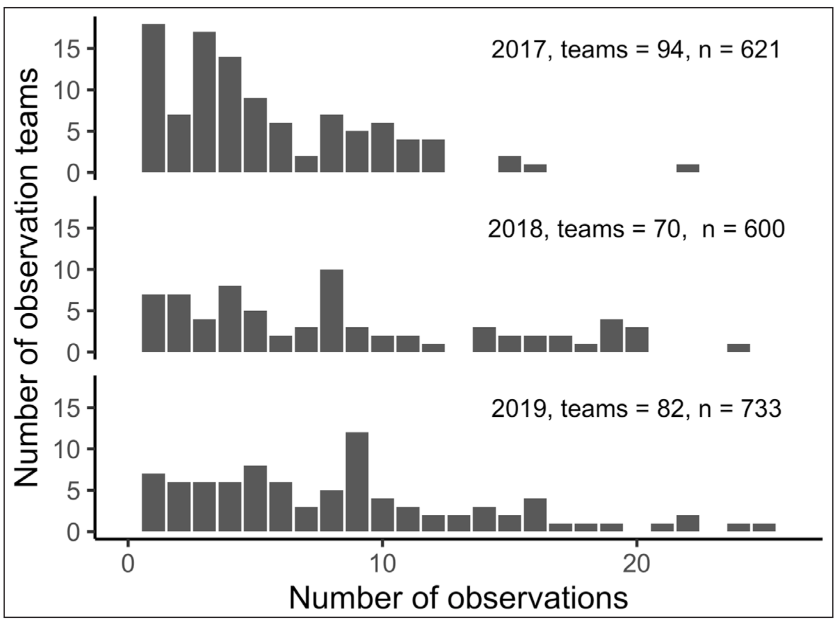

Figure 1 The number of observations varied considerably among teams, from one or two observations to more than 20. (One team, not shown in the figure, collected 33 observations in 2017).

	HOW EDUCATIONAL DID YOU FIND TODAY'S SESSION?	HOW CONFIDENT DO YOU FEEL THAT YOU CAN TAKE PHOTOS OF WILDLIFE THAT COULD BE USEFUL TO A CITIZEN SCIENCE PROJECT?	HOW USEFUL DID YOU FIND THE INTRODUCTION PROVIDED TO YOU BY THE INSTRUCTORS BEFORE YOU WENT OUT TODAY TO GATHER DATA?
Not answered	2.10%	1.10%	1.90%
Not at all	0.20%	1.30%	0.60%
Very little	8.30%	4.30%	8.80%
Somewhat	45.10%	31.80%	20.30%
Very	38.20%	41.90%	50.90%
Extremely	6.00%	19.70%	17.50%

Table 3 Post-survey results: Regarding the educational value of the activity, about 90% of responses were positive responses in the Somewhat, Very or Extremely categories.

the introduction with the instructors, and the time spent gathering data?", 61.3% liked the balance the way it was. Only 4.9% "would have preferred that we spent more time on the introduction, and less time gathering data." And 30.1% "would have preferred that we spent less time on the introduction, and more time gathering data." While we did strike a reasonable balance for most students, if we were going to edit the introduction timing in the future, it would be to shorten it further.

STUDENT ENGAGEMENT AS MEASURED THROUGH OBSERVATION COLLECTION PATTERNS

The number of observations per team was variable for 1 to more than 20 observations during the allotted time (***Figure 1***). Taking into account the time for instruction and the time teams took to walk to their quadrant of the island, there was only approximately 2 to 2.5 hours (120 to 150 minutes) to make observations. To get 30 observations in this time period, a team must stay focused, because that is about 1 observation every 5 minutes. However, if a team has only 1 to 3 observations, that rate of observation is more like a biodiversity stroll than a blitz (or perhaps these teams collected a few observations to meet the requirement, then just chose to have free time). Teams were formed organically at the time of the activity. Team size decreased from about an average of 2.4 individuals in 2017 to 1.5 and 1.6 students in 2018 and 2019. Having more students using their own cameras may make the activity more engaging as far as collecting observations. This is supported by the data, which showed that the average number of people per team decreased in 2018 and 2019, while the number of observations per team increased from 6.7 in 2017 to 8.7 to 9 in subsequent years.

In the second and third years, the number of observations per team increased. In addition, the data quality increased—which is discussed in greater detail by our collaborators in this project (Stevenson et al., in press). In the following section, we discuss possible reasons for these increases based on changes we made to the instructional methods in the second and third years. These changes are described in the Methods Section, and their implications on the amount and quality of observations generated by our students are discussed below.

DISCUSSION

MAIN GOALS FOR THIS STUDY

In this study, we had two main goals: 1) to create an engaging and educational citizen science experience for first-year college students without prior background in the field, and 2) to gather student data while iterating and improving the design of the activity so as to generate insights that may improve future citizen science projects.

ACTIVELY ENGAGING STUDENTS OF ALL MAJORS AND BACKGROUNDS IN CITIZEN SCIENCE

Our post-survey results demonstrate that these students were highly engaged in the citizen science activity, and were confident in their ability to create meaningful data that could be important and relevant to park managers and scientists. These results are consistent with previous studies that show that citizen science projects can be engaging for K–12 students (Harlin et al. 2018) and can improve attitudes of participants toward science (Bonney et al. 2009). This level of engagement was observed despite these students being hesitant in their interest in the activity before it began, and despite their lack of experience with nature or wildlife photography (***Table 1***).

These levels of engagement are notable because these students are a mix of majors from all departments and colleges at UMass Boston. As noted in the Methods, the Honors College has students from every major at the university. Indeed, past studies have shown that participants with an interdisciplinary focus (a priority of most Honors College curricula) are an ideal population for citizen science projects (Bonney et al. 2009).

Past studies have shown a lack of inclusion of people from under-represented minority groups in citizen science (Parrish et al. 2019). As noted in the Methods, we engaged students from UMass Boston, which is the most diverse school in New England (UMass Boston Office of Communications 2020). It has been shown previously that using citizen science projects that focus on nature in urban areas can increase access to citizen science (Dickinson and Bonney 2012). In this study, we have created a program that focuses on nature in urban areas, and implemented it for the student population that is highly diverse (namely, the UMass Boston Honors College—which is reflective of the overall student body at UMass Boston, with 62% students of color in the Honors College specifically, and 54% students of color in the university-wide UMass Boston student body).

GENERATING INSIGHTS WITH IMPLICATIONS FOR FUTURE CITIZEN SCIENCE PROJECTS

In addition to the goal of creating an engaging experience for our own students, our other main goal was to gain insights from student data and from iteratively improving the activity over the three years of the project, which will improve future citizen science projects. Through running this project three years in a row, for 468 students in total, we learned a great deal about what worked qualitatively, in addition to the quantitative data we gathered from the surveys and numbers of observations. We reaped the benefit of taking time to pilot our program in ways that are modeled and recommended by citizen science experts (Bonney et al. 2009).

Demonstrating direct relevance and global importance of citizen science work

During the first year of the program, we tried to emphasize the ability for citizen science–generated data to be relevant and important to global science projects. Indeed, studies have shown that citizen science–generated data can actually be very useful to scientists (Cohn 2008, Raddick et al. 2009). In the first summer of our program, the section of our introductory presentation about the relevance of the student participation was focused on such global examples, but was therefore somewhat theoretical for the students. Past studies have shown that it is important to create a sense of meaning when working with students on citizen science projects (Harlin et al. 2018). Thus, in the second and third years of the program, we showed the students the impact that their work could have. We showed the students an example of an observation made recently in the park that led to entomologists conducting follow-up research. Also, critically, we showed them how many members of the iNaturalist community had identified the species photographed by the UMass Boston Honors College students from the year before. We showed the current students data from the previous batch of students, including the number of observations made, the number that were identified, the number that were identified and confirmed twice and thus labeled Research Grade, and the number of countries from which people worked to identify the images. Seeing these data generated by the previous year's Honors College entering-freshman class seemed to make an impact on the students in real time, based on qualitative observation of their interest, the greater number of observations, and the increased quality of observations by students in 2018 and 2019.

Individual and group incentives

Incorporating past years' data also allowed us to build in an incentive for the students, which we were excited to do because incentives have been shown to be effective in past citizen science projects (Gura 2013). Because the current year of students now knew the amount of data generated by the previous year, we challenged them to try to beat the numbers from the past year by getting a higher number of observations, and a higher number that were identified to Research Grade. Students were offered a pizza party at the end of the year if these measures exceeded that of the year before. Not only did we implement this group incentive, but we also implemented an individual incentive—namely a photo contest for the most beautiful iNaturalist photo from each trip to Thompson Island.

Strategies for increasing student engagement in the field

In the first year of the project, we noticed that while we were out in the field, certain small groups of students seemed to wander off and lose focus from the project. Therefore, we made changes to the project in the second and third years in an effort to increase student engagement.

In the first year, we encouraged students to walk around their assigned quadrant of the island in their small group teams. But this meant that many students were not accompanied by a ranger from the NPS (as there were just 4 rangers present). Therefore, in the second and third years, we encouraged sets of 12 students to remain together in loose groups, with each group focusing on one quadrant of the island, with an NPS ranger present as their guide and available as technical support. The presence of the rangers may also have served as encouragement for the students to remain focused on close observation, rather than choosing to have free time away from the activity.

In the first summer of the project, we had split the students into four groups, and we instructed each one to focus on one category of organisms: fungi, plants, insects, or marine life. But we found that this meant that students would sometimes then not pay attention to an exciting organism that happened not to be in their category, which seemed to reduce the observation total and unnecessarily dampen their natural curiosity. Therefore, in the second and third summers, we did not assign focal types of organisms. Instead, we focused each group on one quadrant of the island, after dividing a map of the island into four roughly equally sized areas, each with a diversity of habitat types.

We also found that providing macro lenses had a clear impact on the level of excitement students seemed to have while taking photos. We incorporated macro lenses in an effort to improve photo quality (see below), but the lenses were a big hit with the students, who seemed to truly enjoy having the ability to magnify the organisms they were observing.

Finally, we decided to give each student an option of returning to the classroom after either 90 or 120 minutes in the field. If they chose to return early, they could work on identifying the images they had taken along with an NPS staff member who also returned early, but if they remained in the field, they could continue to accumulate more observations. Giving the students a choice in the balance of active observation time in the field versus active identification time inside the classroom seemed to work well for the students as we found that a reasonably similar number chose to remain in the field compared with those who chose to return early to begin the identification process.

Strategies for improving quality of photos and observations

In our first year of the project, we noticed several factors that contributed to a less-than-ideal level of quality in the photographs that our students were making, which made the identification process rather challenging (Stevenson et al. in press). We therefore implemented a series of changes in the second and third years.

We provided the students with macro lenses, so that they could take more magnified images of the species they found, and we gave them field guides of organisms common to the Boston Harbor Islands to help them with the identification process.

We also revised our introductory training presentation to directly address common issues with photograph and observation quality. We showed a short screen-capture video of how to use the iNaturalist app so that students could visualize how to make an observation before they even opened the app for the first time. We used examples of actual photographs and observations made in the first year, selecting both good and bad examples. We then engaged the students in the training presentation by asking them which images they thought were good or bad, and why. We demonstrated techniques they could use to improve observation quality, including taking multiple photos of the same organism from different angles, typing in notes for the observation (even if the notes are quite general) so that it is clear what the intended subject of each photo is, and making sure the location is correct on the observation. These strategies are discussed in much greater detail by our collaborators in this project (Stevenson et al. in press). At the same time that we added these elements, we also tried to reduce the overall time the introductory presentation took to deliver.

Finally, we tried to make it as interactive as possible by adding an outdoor element to conclude the training whereby students were guided in collecting one test observation. Interactive training has been shown to be quite effective in past citizen science projects (Harlin et al. 2018).

CONCLUSION: IMPACTING STUDENTS THROUGH A CAMPUS-COMMUNITY PARTNERSHIP

Implementing this activity has shown us what a powerful impact a successful campus-community partnership can have on students, especially the large and diverse student population of UMass Boston, Boston's public research university. We have seen this impact not only through analyzing our pre- and post-survey data, but also through joining our students on the adventure of traveling through the Boston Harbor, from UMass Boston campus to Thompson Island and back.

Invariably, when on the university's boat to Thompson Island with our first-year students, we will hear students say, "I've never been in the Boston Harbor," and they remark on the beauty of the view. There is a moment of realization that this is their campus, and this is their city, Boston, seen from a novel perspective that highlights the nature that surrounds their city. Some of the students have lived in the city all their lives and never had the opportunity to look at it from this vantage point. Under their gasps of surprise lies an emerging awareness of location—and perhaps the first stirrings of desire to learn about this harbor, its islands, and the biodiversity of its inhabitants.

In this study, we have shown that we can take students with little to no experience with the islands and its wildlife, and create an engaging and educational citizen science project that inspires them to want to return to the islands, and to learn more about and to participate in citizen science projects in the future. Students from all majors, with no prior experience with citizen science or iNaturalist, felt that the work they did on our bioblitz was important to the Harbor Islands and to the NPS. By iterating and improving this activity over the course of three summers, we were able to gain insights that will be helpful to those designing citizen science projects going forward, especially in engaging students in close observation of the wildlife and nature directly surrounding them, which they may have never had an opportunity to experience before.

ACKNOWLEDGEMENTS

We would like to thank the staff of the Thompson Island Outward Bound Education Center for everything they do to accommodate our students on these overnight trips, the Honors College staff and student ambassadors for chaperoning these trips and doing the data entry for the pre- and post-surveys, Sophia Bass Werner, Elisabeth Colby, Andrew Petit de Mange, and Bethany Powhida at the National Park Service for guiding students around the island during this activity, Carl Merrill and Peter Burn of Suffolk University for their analysis of the quality of the iNaturalist data, and Brian White at UMass Boston for advice on pre-survey and post-survey development.

COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHORS CONTRIBUTIONS

All six authors designed and implemented the citizen science activity. Drs. Stevenson and Rokop were responsible for the conception of the study, and major aspects of the survey design and data analysis. The three authors from the National Park Service designed and implemented the training. The three authors from UMass Boston contributed to writing the paper.

AUTHOR AFFILIATIONS

Megan Rokop *orcid.org/0000-0002-0995-9993*
University of Massachusetts Boston, US

Rajini Srikanth *orcid.org/0000-0002-2964-8965*
University of Massachusetts Boston, US

Marc Albert *orcid.org/0000-0002-9117-8829*
National Park Service, US

Catherine Radonic *orcid.org/0000-0003-3990-5782*
National Park Service, US

Rachel Vincent *orcid.org/0000-0002-8540-0403*
National Park Service, US

Robert Stevenson *orcid.org/0000-0003-1617-5895*
University of Massachusetts Boston, US

REFERENCES

Bonney, R, Cooper, CB, Dickinson, J, Kelling, S, Phillips, T, Rosenberg, KV and **Shirk, J.** 2009. Citizen science: a developing tool for expanding science knowledge and scientific literacy. *BioScience*, 59(11): 977–984. DOI: *https://doi.org/10.1525/bio.2009.59.11.9*

Bonney, R, Phillips, TB, Ballard, HL and **Enck, JW.** 2016. Can citizen science enhance public understanding of science? *Public Understanding of Science*, 25(1): 2–16. DOI: *https://doi.org/10.1177/0963662515607406*

Braid, B. 2000. City as Text. In: Braid, B and Long, A *Place as Text: Approaches to Active Learning*. Lincoln, NE: National Collegiate Honors Council. pp. 23–26.

Cohn, JP. 2008. Citizen science: Can volunteers do real research? *BioScience*, 58(3): 192–197. DOI: *https://doi.org/10.1641/B580303*

Cultural Survival. 2019. Legacy of Genocide Resurfaces in Boston as Construction Site is Planned on Burial Site. 18 April 2019. Available at *https://www.culturalsurvival.org/news/legacy-genocide-resurfaces-boston-construction-planned-burial-site* (Last accessed 24 June 2021).

Dickinson, JL and **Bonney, R.** 2012. *Citizen Science: Public Participation in Environmental Research*. Ithaca, NY: Cornell University Press.

Dickinson, JL, Zuckerberg, B and **Bonter, DN.** 2010. Citizen science as an ecological research tool: challenges and benefits. *Annual review of ecology, evolution, and systematics*, 41: 149–172. DOI: *https://doi.org/10.1146/annurev-ecolsys-102209-144636*

Gosselin, D, Burian, S, Lutz, T, et al. 2016. Integrating geoscience into undergraduate education about environment, society, and sustainability using place-based learning: three examples. *Journal of Environmental Studies and Sciences*, 6(3): 531–540. DOI: *https://doi.org/10.1007/s13412-015-0238-8*

Gura, T. 2013. Citizen science: amateur experts. *Nature*, 496(7444): 259–261. DOI: *https://doi.org/10.1038/nj7444-259a*

Harlin, J, Kloetzer, L, Patton, D, Leonhard, C and **Leysin American School high school students.** 2018. Turning students into citizen scientists. In: Hecke, S, et al. (eds.), *Citizen Science: Innovation in Open Science, Society and Policy*. London: UCL Press. pp. 410–428. *https://www.jstor.org/stable/j.ctv550cf2.35*. DOI: *https://doi.org/10.2307/j.ctv550cf2.35*

National Collegiate Honors Council (NCHC). 2013. Honors Foundational Documents. 6 November 2013. Available at *http://www.reynolds.edu/get_started/honors/CFE_Hon101_IntroReadings.pdf* (Last accessed 24 June 2021).

National Collegiate Honors Council (NCHC) Place as Text Committee. 2012. Committee Charge. October 2012. Available at *https://nchc.site-ym.com/page/placeastext* (Last accessed on 12 Nov 2021).

Parrish, JK, Jones, T, Burgess, HK, He, Y, Fortson, L and **Cavalier, D.** 2019. Hoping for optimality or designing for inclusion: Persistence, learning, and the social network of citizen science. *Proceedings of the National Academy of Sciences*, 116(6): 1894–1901. DOI: *https://doi.org/10.1073/pnas.1807186115*

Raddick, MJ, Bracey, G, Carney, K, Gyuk, G, Borne, K, Wallin, J, Jacoby, S and **Planetarium, A.** 2009. Citizen science: status and research directions for the coming decade. *AGB Stars and Related Phenomenastro 2010: The Astronomy and Astrophysics Decadal Survey*, 2010: 46.

R Core Team. 2020. R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing. URL *https://www.R-project.org/*.

RStudio Team. 2020. RStudio: Integrated Development for R. Boston, MA: RStudio, PBC. URL *http://www.rstudio.com/*.

Stevenson, R, Merrill, C and **Burn, P.** 2021. Useful biodiversity data were obtained by novice observers using iNaturalist during college orientation retreats. *Citizen Science: Theory and Practice,* In press. DOI: *https://doi.org/10.5334/cstp.407*

Thornberry-Ehrlich, T. 2017. Boston Harbor Islands National Recreation Area: Geologic Sources Inventory Report, National Park Service. March 2017. Available at *www.npshistory.com/publications/boha/nrr-2017-1404.pdf* (Last accessed 24 June 2021).

UMass Boston Office of Communications. 2020. UMass Boston Third Most Diverse College in U.S., Report Finds. 14 February 2020. Available at *https://www.umb.edu/news/detail/umass_boston_third_most_diverse_college_in_us_report_finds* (Last accessed on 1 October 2021).

TO CITE THIS ARTICLE:
Rokop, M, Srikanth, R, Albert, M, Radonic, C, Vincent, R, Stevenson, R. 2022. Looking More Carefully: A Successful Bioblitz Orientation Activity at an Urban Public University. *Citizen Science: Theory and Practice,* 7(1): 1, pp. 1–12. DOI: *https://doi.org/10.5334/cstp.451*

Submitted: 30 June 2021 Accepted: 08 November 2021 Published: 21 January 2022

Citizen Science: Theory and Practice is a peer-reviewed open access journal published by Ubiquity Press.