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Retention and Efficacy of Citizen Scientist Volunteers of the Texas Quail Index

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RETENTION AND EFFICACY OF CITIZEN SCIENTIST VOLUNTEERS OF THE TEXAS QUAIL INDEX

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ABSTRACT

The Texas Quail Index (TQI) was a 5-year, science-based project that utilized citizen scientists to collect data in the field, including 5 indices of bobwhite abundance in the spring, and 3 indices of bobwhite abundance in the fall. Over the course of the study, 84% of all volunteers dropped out of the program and <8% of all data sets were complete. Accordingly, we surveyed the volunteers by mail to determine the rate and cause of participation decline and to identify characteristics of a reliable volunteer. Results indicated that annual volunteer participation rate declined more rapidly as time and labor requirements increased. Similarly, 74.3% of survey respondents who dropped out of the study reported leaving because the project required too much time and work. Motives may have contributed to the volunteer attrition as 72% of volunteers joined the program to learn more about quail management; however 71% of those that left the program reported not gaining knowledge in that area. We recommend that project designs, for citizen-science projects, should incorporate the motives of volunteers and recruit those whose motives best align with project goals. We also recommend that citizen-science coordinators keep volunteer tasks short and within the interest of the volunteer, to increase retention. Finally, we recommend stipends for volunteers on large-scale, laborious projects.

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Key words: citizen science, *Colinus virginianus*, management, motives, northern bobwhite, project design, quail abundance, science, Texas, volunteers.

INTRODUCTION

Citizen-science involves volunteers from the general public gathering data for use by scientists to investigate questions of research importance (Trumbull et al. 2000, Silvertown 2009). Citizen-science programs were established initially as a tool to educate the public about the scientific process (Brossard et al. 2005), but are used increasingly for surveying and monitoring animal populations (e.g., Christmas Bird Count; Lepczyk 2005, Devictor 2010). This trend is likely due to their practicality and affordability in projects where the collection of data is large-scale, time-sensitive, and funding is limited (Altizer et al. 2004). Although practical and affordable, debate continues on whether using citizen scientists is efficient (Irwin 1995, Fore et al. 2001, McCaffrey 2005).

Citizen-science project coordinators seek to recruit volunteers who are reliable and who provide useful data throughout the study; however, the volunteer aspect of citizen-science often results in participants who are initially excited about participating but later drop out of the program (McCaffrey 2005, Rotman e al. 2012, Nov et al. 2014). This pattern was observed with volunteers of the Texas Quail Index (TQI), a 5-year citizen-science project that assessed the relationship between 5 potential predictors of bobwhite abundance in the spring (spring cock-call counts, forb species richness, simulated-nest fate, potential nest-site density, and scent station visitation rates) and 3 indices of bobwhite relative abundance in the fall (roadside counts, fall covey-call counts, and harvest data). The goal of the TQI was to determine if fall quail abundance could be determined by spring predictors (Reyna et al. 2012). An enticement to volunteers and an ulterior goal of the TQI was for citizen scientists to learn more about quail in their area through participation in the project. As a result, 76 volunteers participated in the project over the 5-year period with varying reliability and effectiveness (Reyna et al. 2012).

Several studies characterized different publics (e.g., landowners, hunters) based on their willingness to cooperate in land and wildlife management programs (Raedeke 2001, Sanders 2005, and Wagner et al. 2007). Others have evaluated the motivations and values of citizen scientists in general (Hayghe 1991, Clary et al. 1996, Rotman et al. 2012). One factor common among these studies is that no definitive typology has been determined for a citizen scientist who reliably collects relevant data; thus, the aim of this study was to survey TQI participants to determine motives for engaging and disengaging the program and to identify characteristics of a reliable volunteer so that future citizen-science coordi-

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nators can better recruit and retain volunteers who provide reliable data.

METHODS

Citizen Scientist Characteristics

A mail survey was administered to all volunteers of the Texas Quail Index ($n = 76$) to acquire information regarding their motives for participation, demographics, participant satisfaction, and land ownership goals. The questionnaire was approved by the Texas A&M Institutional Review Board (Protocol number: 2007-0214) and followed Dillman's (2007) Total Design Method which incorporates a personalized multiple mailing approach to achieve an ample response rate for statistical analysis (Dillman 1991).

Initially, pre-survey letters were mailed (day 1) to all volunteers informing them of the forthcoming questionnaire. On day 5, 76 questionnaires were mailed in color print with self-addressed stamped envelopes, followed by 70 post cards (excluding 6 invalid addresses), serving as a thank you or reminder, on day 12. Another black and white questionnaire with self-addressed stamped envelopes was sent to non-respondents only, on day 19. Finally, a concluding postcard (serving as a thank you or reminder) was sent to non-respondents on day 26. All correspondence was personalized by addressing each volunteer by name and by including the signature of the Texas Quail Index coordinator with whom the volunteers were familiar.

Citizen Scientist Participation Rate

Project participation rate is typically shown as a bar graph but such graphs only illustrate the number of total participants each year and lack important information such as the actual time (e.g., month or quarter) participants immigrated to, or emigrated from, the program. Therefore, we first used the Kaplan-Meier Log Rank Analysis (Kaplan and Meier 1958) to determine differences in participation rate among volunteer cohorts (groups trained and starting in the beginning of each year). Subsequently, we used the Kaplan-Meier procedure with modifications from Pollock et al. (1989) to more accurately display the timing of participant decline. Each year of the TQI project was divided into quarters for time scale since harvest-data collection ended in the first quarter and new participants began work in the second quarter of each year (Reyna et al. 2012). For this procedure (modified Kaplan-Meier), we did not censor any volunteers; we only recorded their status as "out of TQI" or "new to TQI". We recorded the number "at risk" as the number of volunteers available for data collection at the beginning of each quarter.

Statistical Analysis

We used SigmaPlot version 12.3 (San Jose, California, USA) to analyze data from the mail survey. Shapiro-Wilk tests for normality were performed on all data sets and t-tests and Mann-Whitney Rank Sum tests were used to analyze differences in motivations, demographics, satisfaction, and landownership goals between those that dropped out of the program (Disengaged), and those that did not (Engaged; Ott and Longnecker 2001). We then conducted logistic regressions to determine which of 9 independent variables predicted whether or not respondents stayed in the program and collected accurate data. Dependent variables were dichotomous (1 = yes, 0 = no) and included "Stayed in the Program" and "Collected Accurate Data"; both questions were asked in the survey. Independent variables included Age (continuous), Role (1 = Landowner, 2 = Agency Biologist, 3 = Other), Previous Citizen-Science Experience (Experience; 1 = yes, 0 = no), Education (1 = High School Diploma, 2 = College Diploma, 3 = Graduate Diploma), Previous Wildlife Courses (1 = yes, 0 = no), Member of Conservation Organization (1=yes, 0=no), Motivation to Join (1 = to learn more about quail management, 2 = to contribute to scientific data, 3 = for fun, and 4 = other), Overall Satisfaction with Program (1 = yes, 0 = no), and Increased Knowledge in Quail Management (1 = yes, 0 = no). We used an alpha of 0.05 to determine statistical significance.

RESULTS

Citizen Scientist Characteristics

Total response rate was 84.3% ($n = 59$ total respondents; 39 Disengaged; 20 Engaged), which included 61.4% response rate for the initial questionnaire, 1.4% for the following post card, 20.0% for the second questionnaire, and 1.4% for the final reminder. Demographic variables did not differ between Disengaged, and Engaged respondents ($P > 0.05$ for age, gender, education, and occupation). Average age for all volunteers was 49 years (± 13.8; standard deviation). Males comprised 93% of respondents, 85% had a college degree, 40% were landowners, 55% agency biologists, and 5% interested volunteers.

The TQI experienced a high turnover rate where 66.1% of all participants left the program (Reyna et al. 2012). Most of the Disengaged survey respondents (61.5%) reported that they left the program because it took too much of their time; 20.5% said they changed jobs and left the area (all agency biologists); 12.8% said it required too much work, and 5.1% believed the data they collected did not matter.

Motivation to join the project did not differ between Disengaged and Engaged respondents ($P = 0.502$) where 72% of respondents joined to learn more about quail management, 11% to contribute to scientific data, 9% thought it would be fun, and 8% said it was recommended as part of their job (all agency biologists). Education and previous experience in citizen-science programs did not differ between groups ($P = 0.545$ and 0.186 respectively). Only 15% of respondents reported previous citizen-science experience, and most (92%) completed at least 1 wildlife course (college or workshop) prior to participating in the TQI.

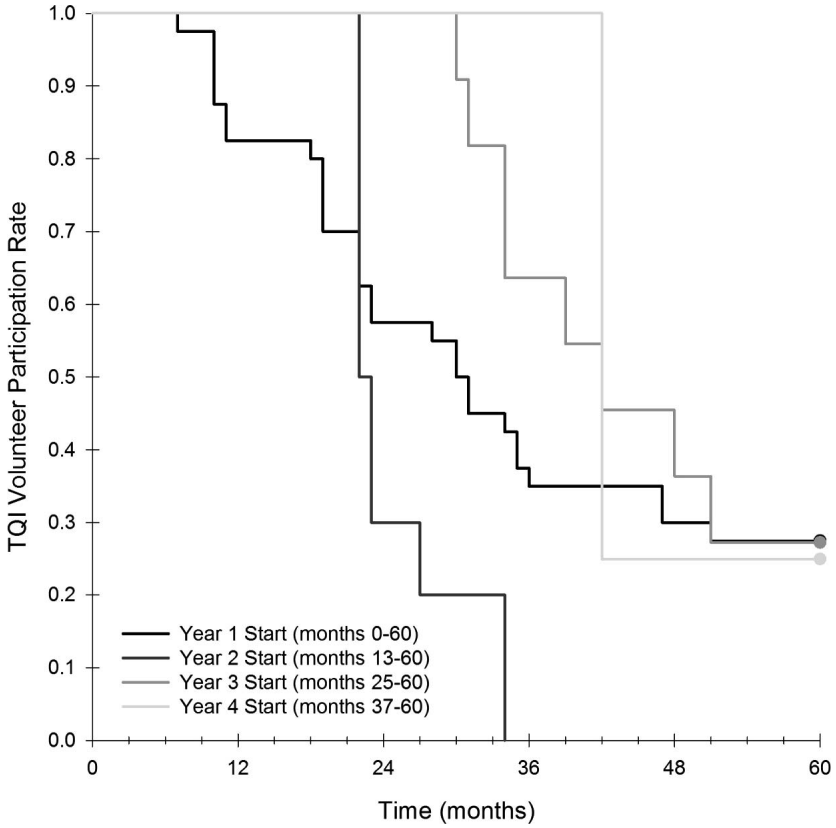

Fig. 1. Kaplan-Meier survival curves illustrating the volunteer participation rate of the Texas Quail Index citizen science project, 2002–2006. Individual curves represent a cohort of volunteers starting each year of the project and their participation rate for the duration of the project. Legend parentheses show potential participation time for each cohort. Time is divided by months and quarters of the project.

Overall satisfaction with the program did not differ between Disengaged and Engaged respondents ($P = 0.163$). Most respondents (75%) were satisfied with communication from TQI coordinators, 85% with quality of training and personal benefits, and 90% said they were satisfied with the overall experience.

Landownership goals were also not different between Disengaged and Engaged participants ($P = 0.695$). Half of sites were used for ranching (50%), 28% hunting, 14% research, and 8% pleasure. Of all sites, 33% reported participating in a landowner incentive program (i.e., an incentive program usually funded by a governmental agency designed to assist landowners in protecting or managing rare species).

When assessing the ulterior or secondary goal, "learning more about quail in your area", more Disengaged participants (71%) reported that they did not increase their knowledge in one or more aspects of the program as compared to 47% of Engaged participants ($P = 0.021$). Combined, participants agreed they learned more about quail abundance estimation, plant identification, habitat evaluation, food sources for quail, quail nesting success, quail calls, and quail locations on associated property. Participants reported they did not increase knowledge in predator abundance estimation, quail response to management actions, or quail biology.

Separate logistic regression models were not statistically significant for each of the dichotomous dependent variables, "Stayed in the Program" ($X^2 = 60.076$, $P = 0.113$) and "Collected Accurate Data" ($X^2 = 39.433$, $P = 0.806$) along with the 9 independent variables.

Citizen Scientist Participation Rate

A Kaplan-Meier Log Rank Survival Analysis with multiple comparisons showed that participation by the volunteer cohort in year 2 of the TQI (2003) was different than all other years, where all year-2 participants dropped out of the program ($P < 0.001$; Figure 1). Further, a modified Kaplan-Meier survival analysis using a cumulative participation rate of cohorts showed that participation rate declined significantly in the 3rd and 4th quarters of each year except year 4 where participation began declining in quarter 2, and in year 5 where participation rate was steady. However, year 5 cohorts did have some disengaged participants (Figure 1) but individuals from previous cohorts stayed engaged resulting in a steady participation rate for that year (Figure 2). Combined, both analyses demonstrate that recruitment and retention declined over all 5 years.

DISCUSSION

The high response rate to the TQI questionnaire (84.3%) was more than sufficient to overcome nonresponse bias (Dillman 1978), especially without the use

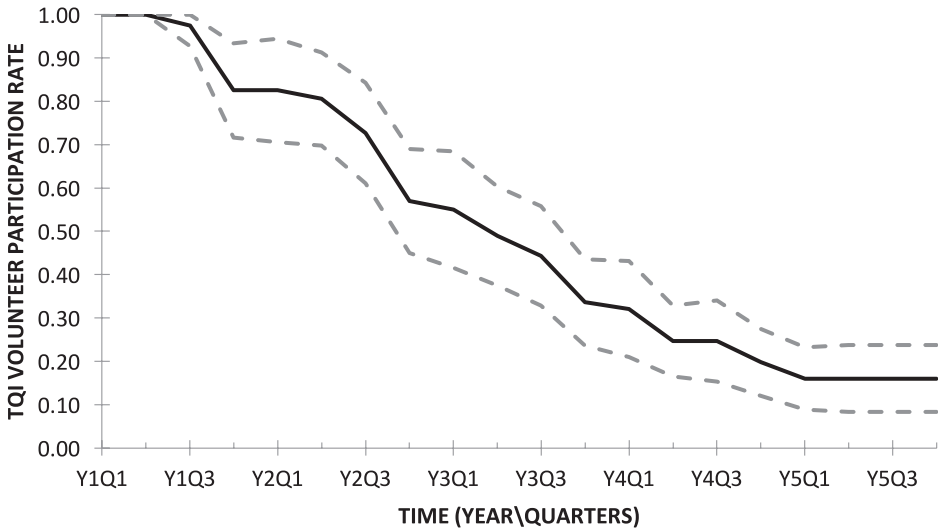

Fig. 2. Kaplan-Meier survival curve illustrating the volunteer participation rate of the Texas Quail Index citizen science project, 2002–2006. Time is divided by years and quarters. Dashed lines represent 95% confidence intervals.

of an incentive to respond (Dillman 2007). This was likely realized because of several factors. Although many TQI participants left the program, the nature of their bond with Texas AgriLife Extension remained through other programs and workshops. With branded envelopes and letterhead, the response rate could have been high simply because of familiarity and trust (Dillman 2007). The professional style of the survey documents (i.e., personalized greetings, color print, and personal signature) likely represented that relationship in a positive manner and may have made a better visual impact on volunteers than a standard form letter (Dillman 2007). By nature, citizen scientists have a personal interest of self-education and a desire to contribute to science (Rotman et al. 2012); responding to a survey from a trusted source was an easy way to accomplish both goals and likely increased survey response.

Citizen Scientist Characteristics

Although no differences were detected between Disengaged and Engaged participant demographics, satisfaction with program, or landownership goals, which prohibited us from determining the characteristics that contributed to a reliable citizen scientist for the TQI project, we did find differences in knowledge gained from the program. This is particularly interesting when paired with the primary motivation and incentive to join the program reported by respondents, "To learn more about quail." Seventy-one percent of respondents that left the program stated they did not gain knowledge in at least one quail related area (primarily quail management), compared to 47% of those that remained throughout the duration of the program (Figure 3). While the TQI had the goal and incentive, albeit secondary, of providing educational opportunities for citizen scientists (i.e., to learn more about quail), the project was designed and managed around the goal of conducting science with virtually no project design considerations for citizen scientists other than training them to collect and submit data. In general, citizen scientists were utilized as an economical data collection means. This is typical of citizen science projects and one of the main reasons they fail to reach their full potential (Rotman et al. 2012). In fact, scientists who have studied the efficacy of citizen-science projects have largely concluded that volunteer motivation must be factored into project design and that project typology or objectives should be clearly stated, *a priori*, in order to recruit and retain citizen scientists with similar goals (Jordan et al. 2011, Wiggins and Crowston 2011, Rotman et al. 2012, Nov et al. 2014). For example, Wiggins et al. (2011) surveyed the citizen-science literature and determined that most projects fall into 5 categories: Action, Conservation, Investigation, Virtual, and Education. These typologies are not absolute and projects often overlap categories; however, each project type required a different management style and projects were more successful in reaching intended goals when volunteer motives were matched to project typology (Jordan et al. 2011, Nov et al. 2014). Thus, citizen scientists that are seeking education should be recruited for and implemented into projects whose primary purpose is to increase awareness or educate volunteers. The TQI did not incorporate any volunteer motivations into project design other than the notion that collecting data on their land would result in more knowledge about quail management on their land. The project did not seek to connect those interested in science with more of the scientific portion nor did it entail any lessons learned or quail management modules specifically to participants. Rather, all volunteers were treated equally and tasked only with data collection and submission. This inadvertent failure to incorporate citizen scientists into project design could be one major factor contributing to the rapid decline of volunteer participation (Jordan et al. 2011, Nov et al. 2014).

In addition to potential project design problems, the TQI was time-consuming and labor-intensive compared to

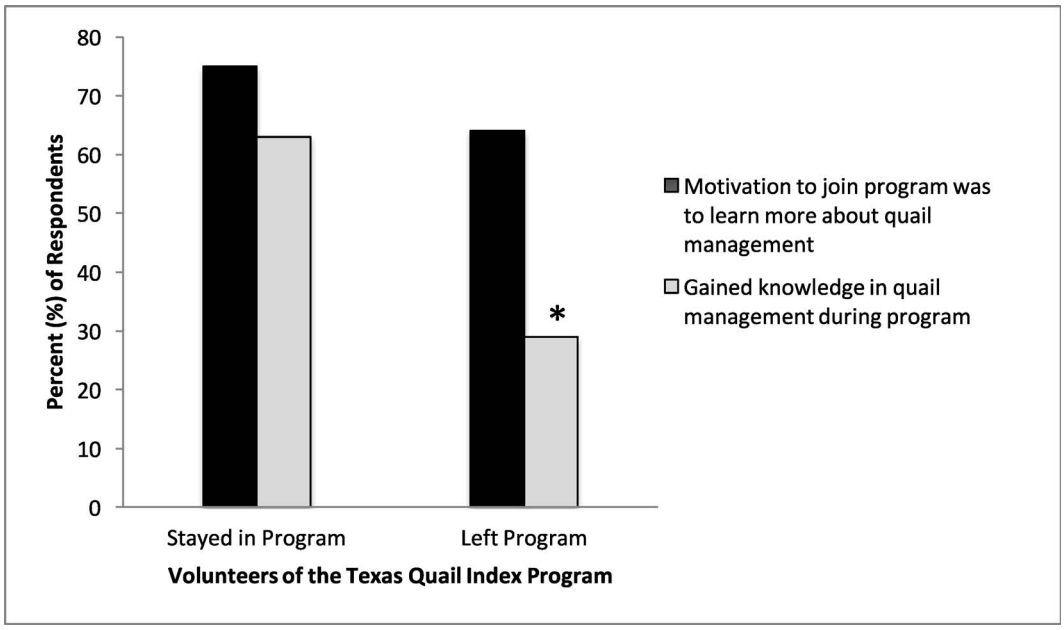

Fig. 3. Percentage of respondents to the Texas Quail Index Program post survey who joined the program to learn more about quail management (black) and who reported they gained knowledge in quail management during the program (grey). More respondents reported gaining knowledge in quail management during the program if they stayed in the program as compared to those that left early ($P = 0.021$). Statistical significance denoted by asterisk.

average citizen-science projects such as Project Feeder Watch (Cornell Lab of Ornithology 2007), the Christmas Bird Count (National Audubon Society 2007), or the North American Breeding Bird Survey (United States Geological Survey 2007). Most Disengaged participants (74.3%) reported they left the TQI because it was excessively time or labor intensive. Time required annually exceeded 60 hrs, not including travel to and from study sites (Reyna et al. 2012). The most collected variables of the TQI were the indices of relative abundance (call counts and roadside counts) which took about 4 hrs per outing and varied according to weather conditions and transect smoothness (i.e., for rougher transects, the volunteers had to drive slower). These indices of relative abundance are typical data to be recorded by volunteers in citizen-science programs. The least recorded variables of the TQI occurred in the 3rd quarter of each year, which entailed the most observable participation decline (Figures 1 and 2) and included the most laborious and time consuming data collection. Simulated-nest surveys (dummy nests) took $\geq$6 hrs to establish and approximately 8 hrs to check although the amount of time required checking the nests varied according to ease of finding them, which was often difficult. Predator scent-stations, forb species-richness, and habitat photos all required about 4 hrs to conduct and a moderate amount of labor (Reyna et al. 2012). Scent-stations were often rendered unusable because of precipitation and animal disturbance which some respondents considered frustrating and a waste of time (Reyna et al. 2012). These time estimates were for blocks of time, meaning all work within a task was done during one session; a large demand on a working adult's time. Although these laborious and time consuming tasks where not out of the question for payed technicians of a program, and volunteers were told about the time and tasks during training, it is easy to understand why the majority of Disengaged reported time and labor as the primary reason for leaving the program; it was too much work and this was not their primary job.

Further, the TQI lacked stipends and the only incentive to remain in the program was simply to learn more about quail (i.e., not monetized). This ulterior motive of the TQI may have been viewed as only a minimal enticement since nearly all citizen-science programs are designed to increase the scientific knowledge of the volunteer (McCaffery 2005). The TQI program did not reimburse volunteers for most project-related costs, including fuel for vehicles, photograph development, and supplies, so it is possible that the net benefit to some volunteers was perceived to be negligible. Most citizen-science projects lacking stipends are small-scale from the perspective of the volunteers and require very little labor and out-of-pocket expense. Most large-scale projects compensate volunteers for expenses and sometimes offer a stipend, resulting in increased productivity and likelihood of future service (Tschirhart et al. 2001).

Conclusions and Recommendations

The Texas Quail Index was a science-based project that utilized citizen scientists to collect data. The high rate of decline mimicked McCaffery's (2005) observation of participants being initially excited about collecting data and being involved in the scientific process, but later leaving the program. The TQI had a high rate of interest by volunteers but those interests (quail management

education) did not line up with programmatic goals (quail science). Combined with an atypical amount of labor and time requirements, volunteer participation declined rapidly.

Debate will likely continue on whether or not citizen scientist data is reliable (Irwin 1995, McLaughlin and Hilts 1999, McCaffery 2005, Conrad and Hilchey 2011, Reyna et al. 2012) however, with technology continually making it easier to ensure data is collected properly (Yu et al. 2010, Kim et al. 2011), and with collaborative programs driving the future of citizen science along with technology (Sheppard and Terveen 2011), it is likely citizen scientist projects and programs will continue. Accordingly, we make the following recommendations as a result of our lessons learned. First, recruitment, project design, and management should incorporate the motives, interests, and typologies of volunteers. Rotman et al. (2012) found that volunteer motivation and interests changes during the duration of a project and that project managers should survey volunteers before the initiation of the project, and on a frequent basis thereafter, to better assign volunteers to tasks that align with their ever-changing motives. This further emphasizes the need to incorporate the motives of citizen scientists into project designs, or recruit volunteers whose typologies match programmatic goals. Ultimately, where these motivations are ignored volunteer participation declines (Jordan et al. 2011, Wiggins and Crowston 2011, Rotman et al. 2012, Nov et al. 2014). Second, citizen-science coordinators should keep volunteer tasks short and within the interest of the volunteer; long laborious projects are better left to payed employees. Most citizen scientists programs involve volunteers performing short tasks or collecting data in groups for one day or a series of well-planned short days (Cornell Lab of Ornithology 2007, National Audubon Society 2007, United States Geological Survey 2007). The TQI lost most of the volunteers due to time and labor intensiveness and as a result, data collection suffered (Reyna et al. 2012). Finally, our survey did not capture stipends or cost reimbursements contributing to the decline of volunteer participation but our review of the literature overwhelmingly emphasized that these factors play a big role in volunteer retention in long-term, large-scale projects, i.e., don't let the project be a cost to the volunteers but rather a benefit aligned with their motives.

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