CITIZEN SCIENCE:
THEORY AND PRACTICE

Participation Intensity Influences Motivations for Contributing to iNaturalist

RESEARCH PAPER

SAMANTHA K. LOWE
BRITTANY M. MASON
ROBERT GURALNICK
NIA A. MORALES
COREY T. CALLAGHAN

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

]u[ubiquity press

ABSTRACT

Understanding how motivations for participating in citizen science projects change as a function of participation can help enhance recruitment and retention strategies. Previous studies indicate that motivations focused on science and conservation often become more important over time, while egoistic motivations tend to decline in importance. Here, we investigate how participant motivations change as a function of participation level by surveying users of the citizen science platform iNaturalist. We surveyed 429 iNaturalist users using a combination of quota and convenience sampling methods. Participants rated the importance of 15 motivations on a five-point Likert-type scale and provided their total number of contributions to iNaturalist, allowing us to analyze how the importance of motivations varied with participation intensity. Our findings revealed that learning-oriented motivations, specifically improving species knowledge and discovering information about ecosystems, consistently ranked as the most critical motivations regardless of participation intensity. Science and conservation motivations gained importance with increased observation counts but did not surpass learning motivations. Contrary to prior findings, egoistic motivations either maintained or increased in significance at higher participation levels. These insights into iNaturalist users' motivations suggest the potential need for tailored engagement strategies that account for learning and curiosity-driven participation in citizen science.

CORRESPONDING AUTHOR:
Samantha K. Lowe
Graduate Student (MSc), School of Natural Resources and Environment, University of Florida, US; Institute of Food and Agricultural Sciences, University of Florida, US
samantha.kae.lowe@gmail.com

KEYWORDS:
citizen science; community science; motivation; participation; iNaturalist; participatory science

TO CITE THIS ARTICLE:
Lowe, S.K., Mason, B.M., Guralnick, R., Morales, N.A. and Callaghan, C.T. 2025. Participation Intensity Influences Motivations for Contributing to iNaturalist. *Citizen Science: Theory and Practice,* 10(1): 25, pp. 1–15. DOI: https://doi.org/10.5334/cstp.823

INTRODUCTION

The field of participatory citizen science (also referred to as community science) gives volunteers an opportunity to engage in science by collecting, sharing, and analyzing data (Jordan et al. 2015). Citizen science is growing in popularity, as evidenced by an increase in the number of ecological and environmental citizen science projects over the past 20 years (Pocock et al. 2017; Maund et al. 2020). Data from these projects are increasingly used in research; for example, by tracking the distribution and abundance of many types of organisms (Bonney et al. 2009; Dickinson, Zuckerberg, and Bonter 2010; Larson et al. 2020). The status of biodiversity conservation measures and effectiveness of natural resource protection efforts can also be extrapolated from citizen science data, making this data a valuable, yet cost-effective, tool for scientific research and natural resource management (Larson et al. 2020; Sbrocchi 2014; Soteropoulos, De Bellis, and Witsell 2021). However, the sustained success and effective collection of citizen science data relies on successful volunteer recruitment and retention (Alender 2016; Asingizwe et al. 2020). Understanding the diverse motivations of citizen science participants is important to encourage effective engagement.

Participant motivations have proven to be diverse and complex (Bible and Clarke-De Reza 2023; Rotman et al. 2012). The psychological motivations of volunteerism (Anderson and Moore 1978) underpin research on what motivates citizen science participants (Larson et al. 2020). In part, motivations align with personal benefits and positive outcomes citizen science initiatives offer participants. Such outcomes include improved understanding of scientific topics, scientific skill development, and increased confidence (Land-Zandstra, Agnello, and Gültekin 2021; Nguyen and Tran 2023). Multiple frameworks exist to categorize and differentiate among motivations. For example, Batson, Ahmad, and Tsang (2002) present a framework that categorizes motivations into four psychological distinctions: egoism, altruism, collectivism, and principlism. In this framework, distinctions are made based on whether a person is motivated by self-interest, concern for others, loyalty to a group, or adherence to moral principles.

Ultimately, across all frameworks, personal values drive a person's motivations to participate (Batson, Ahmad, and Tsang 2002), and people mainly participate in projects that match their motivations (West, Dyke, and Pateman 2021). Previous studies have found that motivations for environmental volunteering can differ according to a variety of participant characteristics including participants' residence (Measham and Barnett 2008), age, gender, education level, socioeconomic status, and ethnicity (West, Dyke, and Pateman 2021). Although participant motivation varies greatly, previous studies have consistently found that participants are highly motivated to conduct citizen science to contribute to science and conservation (Bowler et al. 2022; West, Dyke, and Pateman 2021; Larson et al., 2020; Maund et al. 2020; Alender 2016). These studies, like most studies about citizen science participant motivations, focus on individual projects with a potentially narrow user base (West, Dyke, and Pateman 2021), making their results informative, but not necessarily generalizable to other projects.

While an increasing body of research has investigated the motivations of citizen science participants (e.g., West, Dyke, and Pateman 2021; Maund et al. 2020; Bowler et al. 2022; Alender 2016), far less research has studied how these motivations change over time. Some studies (e.g., Larson et al. 2020; Asingizwe et al. 2020) have examined the differences between participants' initial motivations and current motivations, finding that contributing to science and conservation is an especially important motivator for continued participation. Collectively, these studies, combined with others that don't necessarily test for changes in motivation sequentially through time (e.g., Maund et al. 2020; Alender 2016; Thompson et al. 2023), provide a foundation to inform predictions regarding shifts in participant motivations over time. For example, a participant might begin a project to benefit their career, but this motivation might decrease through time because continued motivations tend to be less egoistic and more collectivistic (Bible and Clarke-De Reza 2023). We may also expect outdoor exploration and recreation, an egoistic motivator (Larson et al. 2020), to decrease in strength as a motivation over time as participants become increasingly influenced by collectivist motivations over egoistic ones (Bible and Clarke-De Reza 2023).

Our overall objective was to examine how participant motivations change as a function of participation intensity (i.e., as a function of time spent using the platform). We anchor our research design in previous studies that have looked at motivations of citizen science participants and develop hypotheses as to why some of these motivations are likely to differ as a function of participation (see Table 1 for a detailed overview of motivations and hypotheses). Understanding how these motivations might evolve throughout a participant's time on a platform is important for designing strategies to both recruit new participants and retain current participants, enhancing the long-term success and sustainability of participatory citizen science initiatives (West, Dyke, and Pateman 2021; Larson et al. 2020; Maund et al. 2020; Alender 2016; Measham and Barnett 2008; Batson, Ahmad, and Tsang 2002).

MOTIVATION	HYPOTHESES
Science and conservation	We predict that the motivation to contribute to scientific research and conservation efforts will be a prevalent motivator for all participation levels and (based on Larson et al. 2020) will be more important for longer term/higher observation count participants.
Fun	We predict that personal enjoyment will be of medium importance as a motivation. We predict that it will be more important for participants with more participation experience, based on Bible and Clarke-De Reza (2023).
Discovery and species knowledge	We predict that this will be an important motivation because it was cited as an important motivator in many studies. Based on Asingizwe et al. (2020), we predict that learning will be a more important motivation for lower-level, newer participants.
Building friendships	We predict that this will not be an important motivation for any participation level. While iNaturalist offers an online social network between users and identifiers, Maund et al. (2020) point out that projects not requiring training lack a social component. Their study used a large-scale online platform that is more similar to iNaturalist than other citizen science projects from relevant research.
Career	We predict that career development will be an unimportant motivation because in Bruyere and Rappe (2007), Alender (2016), and Maund et al. (2020) this was the least important motivator of those cited. Based on West, Dyke, and Pateman (2021) and Alender (2016), we expect career development to be more important for low-level participants (who are more likely to be young, novice citizen scientists).
Recognition	We predict that recognition will not be an important motivation due to iNaturalist's lack of recognition methods. Based on Asingizwe et al. (2020) and Nguyen and Tran (2023), we predict that recognition will be more important for participants with more observations.
Connection	Based on the results of Larson et al. (2020), we predict connection with nature will be an unimportant motivation overall, but will be less important for lower-participation groups than higher-participation groups.
Getting outside and exercise	Based on the results of Larson et al. (2020), we predict outdoor exploration and recreation will be a less important motivation overall, but, as an egoistic motivator, will be more important for lower-participation groups than higher-participation groups (Bible and Clarke-De Reza 2023).
Protecting nature	We predict this motivation will be more important for long-term, experienced participants because collectivism is more important for sustained participation (Bible and Clarke-De Reza 2023; Bowler et al. 2022; Bruyere and Rappe 2007).
Citizen science	Based on the "values and esteem" motivator in Bruyere and Rappe (2007), we predict that moral beliefs will be of medium importance as a motivation. Because egoism tends to dominate initial motivators, we predict this will be more important for participants with more observations.
Direct request	We predict that being asked to participate by an organization or instructor will not be important overall. However, we do think this motivation will be stronger for lower participation levels (i.e., new users) (West, Dyke, and Pateman 2021; Maund et al. 2020; Hitchcock, Sullivan, and O'Donnell 2021).
Right thing to do	We predict this will be an important motivation for participation based on its prevalence in the research of Measham and Barnett (2008) and West, Dyke, and Pateman (2021). We predict this will be more important for users with more participation.

Table 1 Hypotheses for how motivations will change with increasing participation.

Note(s): Motivations in this table are abbreviated versions of those found in the survey. Refer to Supplemental file 1: Supplementary Table 1 for full motivations as well as explanations of their meanings, a complete list of references supporting their inclusion in the survey, and the results of their importance among survey respondents.

METHODS

SAMPLING INATURALIST PARTICIPANTS

We chose to study users of iNaturalist, a global biodiversity observation platform that is often used for citizen science, to gain insights into how motivations for participating in citizen science change as participation increases. iNaturalist is an online platform that allows users to upload photographic or audio evidence of any organism they encounter. When submitting observations, users are provided with suggested identifications based on species known to be present in the observation's location and on a computer vision model trained with the photographs of other users and their associated identification labels from the iNaturalist community. Once submitted, other users may confirm or suggest alternate identifications on the observation. Observations that have a consensus of at least 2/3 of species-level identifications are considered "Research Grade" (iNaturalist 2024b). iNaturalist is one of the most popular global citizen science platforms, with over 3.4 million users, about half of whom (1.8M) are based in the United States of America (US) (iNaturalist 2024a;

Loarie 2024). Unlike other citizen science initiatives, iNaturalist lacks a rigid protocol, allowing users great flexibility in the quantity of observations they submit and the taxonomic groups they prefer. This flexibility creates a user base with a large variance in observation counts (Di Cecco et al. 2021), over a broad spectrum of time on the platform. Users may join iNaturalist independently through word of mouth, social media, or by discovering the app organically. Others may be introduced to the platform through organized outreach events, such as bioblitzes, where participants are encouraged to document as many species as possible using iNaturalist. At its core, iNaturalist describes itself as "an online social network of people sharing biodiversity information to help each other learn about nature" (iNaturalist 2025). The platform promotes its ability to help users identify plants and animals while contributing to science and conservation. It also emphasizes the opportunity to connect with a global community of naturalists. This wide range of features and benefits is likely to appeal to users with diverse motivations for joining the platform.

SURVEY DESIGN AND CONSTRUCTION

We created a survey assessing users' current and initial motivations for using iNaturalist, other iNaturalist usage metrics, and individual user demographics (see Supplemental file 2: Appendix 1 for a full copy of the survey). Participants were asked to rate, on a 1–5 ("not at all important" to "extremely important") Likert-type scale, how important 15 motivations are for their current use of iNaturalist. Motivations were identified using previous research on citizen science participation that would be applicable to iNaturalist participation (Larson et al. 2020; Bible and Clarke-De Reza 2023; Maund et al. 2020; Bowler et al. 2022; West, Dyke, and Pateman 2021; Alender 2016; Bruyere and Rappe 2007; Hitchcock, Sullivan, and O'Donnell 2021; Measham and Barnett 2008; Carballo-Cárdenas and Tobi 2016) and by drawing on our familiarity with the iNaturalist platform and its user base. See Supplemental file 1: Supplementary Table 1 for an overview of the 15 motivations used in our survey. Participants then ranked any current motivations they indicated as "very" (4) or "extremely" important (5) from most to least important (1 to n) and were asked to select up to 3 motivations as their top motivators for initially using iNaturalist. Next, the survey asked about participants' iNaturalist usage metrics including their number of observations, their time on the platform, and their username. Participants were also asked to provide demographic information (e.g., age, race/ethnicity, gender, education level). Participants had the option to leave questions about user metrics and demographics unanswered.

We piloted the survey from January 9th to January 31st, 2024. The survey was sent to undergraduate students, graduate students, and faculty via listservs for two conservation-related departments at an R1 university in the southeastern US. During the three-week pilot period, the survey received 49 responses. The piloting process gave us a chance to receive feedback to make changes that made the survey easier to complete for respondents, ensuring clarity of the questions. We calculated the inter-item correlation matrix among the motivations rated on a Likert-type scale, noting any motivations that had correlations greater than 0.7 with one or more motivations, likely indicating overlap in the concepts being assessed by those motivations (Piedmont 2014). We used this approach to identify redundancy and subsequently combined or eliminated motivations (20 motivations piloted compared with 15 in the final survey). As an example, in the pilot survey, contributing to science and contributing to conservation were separate motivations that were highly correlated (0.813). We therefore combined these two motivations in the final survey.

SURVEY DISTRIBUTION

The survey was designed in and distributed using the Qualtrics online survey platform. In each survey, the order of the motivations was randomized to negate any effects on ranking due to order. To ensure the robustness of our conclusions and to maximize our chances of a robust recruitment strategy, we distributed the survey two ways, using both a quota sample and a convenience sample.

Quota sample

To capture the diversity of user experiences—in terms of level of intensity of participation—on iNaturalist (Di Cecco et al. 2021), we stratified our sample a priori based on user observation count to explore the motivations of users with different participation levels. Our approach used observation count as a proxy for the duration and intensity of user engagement, supported by the positive relationship we observed between number of observations and length of time using iNaturalist (Pearson correlation coefficient = 0.217, p-value < 0.005) (Supplemental file 3: Supplemental Figure 1). This allowed us to capture a gradient of participation levels, from novice to highly experienced users, and explore how motivations evolve with increased engagement in citizen science activities. We focused our sampling on the US. With more than 1.8M users, the US offered a suitable sample pool of users to request. To compile a list of US iNaturalist users, we downloaded all Research-Grade iNaturalist observations from the Global Biodiversity Information Facility (GBIF) (GBIF.org 2023) and determined the number of observations per country

for each user. If the US was the country with the most observations, then that user was assumed to be a US iNaturalist user. Because GBIF stores only Research-Grade observations and we are interested in the total number of observations for each user regardless of quality, we used the iNaturalist Application Programming Interface (API) to get user information based on the users we identified as being based in the US (iNaturalist 2024a). The number of observations among users is distributed unevenly, with about one half of US iNaturalist users having less than 10 observations. Based on this, categorical stratified groups were made so that they captured different levels of users, but still had enough users to sample at least 100 people. The five groups were 5–10, 11–50, 51–300, 301–1,000, and > 1,000 observations. We sent a survey request using the direct message feature on the iNaturalist platform to contact individual users. Because receiving this message requires users to have some level of engagement with the iNaturalist platform, we decided to sample users with a minimum of five observations who been active within the three months prior to sampling (N = 11,856). We used the iNaturalist API to determine the date of last activity by obtaining the most recent observation for each user (iNaturalist 2024a), and considered users that submitted observations between December 1st (2023) to February 19th (2024) as recently active. With the dataset of users meeting these criteria, we randomly sampled 100 users from each of our five groups and, between March 1st and March 7th (2024), sent survey requests to these 500 people.

To collect comparable amounts of responses for each observation group, we resampled any group that did not exceed a 20% response rate three weeks after a request was sent. Based on this, we randomly sampled 100 additional users with 5–10 observations and another 100 users with 11–50 observations between March 26th and March 30th via iNaturalist direct messaging. In total, we sent 700 survey requests and received 208 responses (29.71% response rate) before closing the survey on July 19th, 2024. The individual response rates of each of the five groups can be found in Supplemental file 4: Supplemental Figure 2.

Convenience sample

In addition to our quota sample, we opened the survey up to all iNaturalist users in a convenience sampling approach. Given that Spanish is the second most common language spoken in the US (USCB 2022), and that the iNaturalist app is available in Spanish (among other languages), we created a Spanish version of the survey with the same structure and content to increase the response potential during this phase of sampling (see Supplemental file 5: Appendix 2). We opened the survey to any iNaturalist user on May 3rd, 2024 by promoting it on university listservs, sending it to natural science students and faculty to promote within their own networks, and posting an ad for the survey on X (formerly Twitter). The convenience sample survey ran for 11 weeks and collected 221 responses. Across both sampling methods, we collected a total of 429 responses.

STATISTICAL ANALYSIS

We initially compared the results from the quota and convenience samples separately, examining the distribution of responses across observation count groups (Supplemental file 6: Supplemental Figure 3) and the Likert ratings for each motivation (Supplemental file 7: Supplemental Figures 4 and 5). Both samples identified species knowledge and ecosystem discovery as the most important motivations, and recognition and career advancement as the least important (Supplemental file 7: Supplemental Figure 4). Furthermore, when comparing the proportion of "very" or "extremely" important responses for each motivation, we observed a strong positive correlation between the two samples (correlation coefficient = 0.936; Supplemental file 7: Supplemental Figure 5). Based on this, we combined both samples to enhance statistical power and generalizability as we did not qualitatively or quantitatively notice any systematic differences to justify separate treatment.

We performed statistical analyses using observation count as both a categorical and continuous variable. At the time of taking the survey, 404 respondents (94.2%) provided their observation count within one of six prescribed ranges which corresponded with five categorical groups after we combined "0–4" and "5–10." Analyses involving categorical observation count were based on these responses. In addition to a categorical observation count, for many respondents (n = 323, 75.3%) we were able to retrieve an exact observation count and perform additional analyses with observation count as a continuous variable. To do this, we used the iNaturalist API to collect an observation count for each respondent who provided their username. The observation count was taken from the date they took the survey.

The Likert-type ratings for each motivation, although sometimes visualized using values from 1 to 5 for readability, were treated as ordinal variables because the difference between each level of importance cannot be quantified and is not necessarily even (Göb, McCollin, and Ramalhoto 2007). To test if the ratings of each motivation had relationships with categorical observation counts, we performed Chi-squared tests of independence (Msuha and Mdendemi 2019). To test if the ratings of each motivation had relationships with observation count as a continuous variable, we performed ordinal regressions using the ordinal

package in R (Christensen 2023). These regressions used cumulative link models, used to analyze ordinal response variables by estimating the probability of an observation falling into a particular category based on predictor variables (Christensen 2011). Since the continuous observation count was positively skewed, we added 1 to account for the few respondents who had 0 observations and then log transformed this variable (Ives 2015). We also examined the Pearson correlation of continuous observation count and respondents' years on iNaturalist (Sedgwick 2012). All analyses and visualizations were done using the statistical programming language R 4.4.0 (R Core Team 2024).

RESULTS

DEMOGRAPHICS OF SURVEY PARTICIPANTS

We collected a total of 429 responses pooled across both sampling methods. Of those respondents, 48.8% identified as female, 38.7% identified as male, and about 4% of respondents identified as non-binary, non-gender conforming, two-spirited, or self-identified. A majority of respondents were younger than 45 years old: 21.9% ages 18–24, 26.1% ages 25–34, and 16.3% ages 35–44 (totaling 64.3% of respondents). Respondent ages ranged from 18 to 75+. A majority of respondents (65.7%) selected only White/Caucasian as their race/ethnicity, with the remaining respondents identifying more than 30 combinations of mixed races/ethnicities. We found that 76% of respondents completed a higher-level education degree: 38.9% Associate or Bachelor's degree and 37.1% graduate or professional degree. When asked about occupation, 60% of respondents indicated that their primary area of expertise is in life sciences, natural resources, or conservation. No income bracket represented a majority of respondents, however 56% of respondents had household incomes less than $100,000 annually.

OVERALL MOTIVATIONS FOR CONTRIBUTING TO CITIZEN SCIENCE

The importance of each of the 15 motivations presented in the survey varied greatly across all respondents (Figure 1). Motivations with the highest combined percentages of "very" and "extremely" important ratings were considered to be most important for iNaturalist users' current participation. The motivations that received greater percentages of high-importance ratings compared with other motivations were "Improving my knowledge about species, especially by identifying species I am unfamiliar with" (92% of respondents ranked this "very" or "extremely" important) and "Discovering new information about ecosystems where I live" (84%). Six motivations, including "Having fun" and "Getting outside and enjoying time in nature," received very similar percentages of high importance ratings ranging from 71–78% (Figure 1). Motivations with the highest combined percentages of "not at all" and "slightly" important rankings were considered to be most unimportant for iNaturalist users' current participation. Five motivations received ratings indicating unimportance from over 50% of respondents: "Gaining recognition and respect

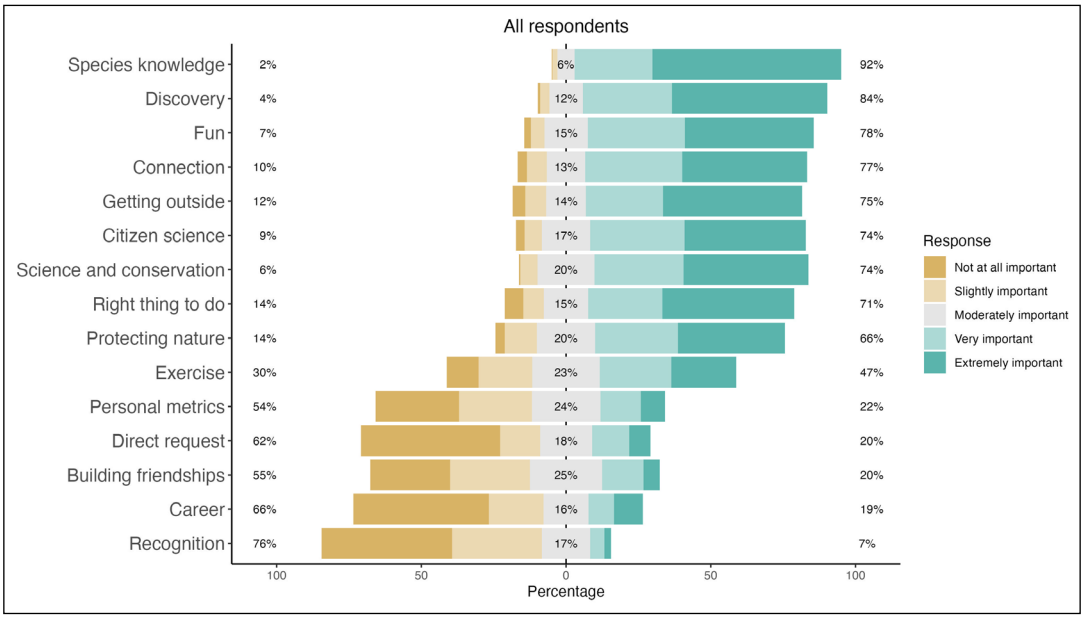

Figure 1 Fifteen motivations for why respondents currently use iNaturalist, rated on a 5-point Likert-type scale of importance. Ratings from all respondents (n = 429) are shown. Motivations are ordered from top to bottom in descending order of percent of "very" or "extremely" important responses.

from others" (76% of respondents ranked this "not at all" or "slightly" important), "Advancing my current or future career" (66%); "Responding to a direct request (through my education or another organization)" (62%); "Building friendships with other people who enjoy using iNaturalist" (55%); and "Watching my personal metrics on the platform increase as I submit more observations" (54%).

Respondents indicated up to three of their most important initial motivations for beginning to use iNaturalist. The most popular initial motivation, marked by 72% of respondents, was improving my own species knowledge, with the next most popular initial motivation—discovering information about ecosystems—marked as initially important by only 41.5% of respondents. The least popular initial motivation was gaining recognition, marked by only two respondents (0.47%). The percentage of respondents that marked each of the other motivations as initially important can be found in Table 2. Most motivations remained important for respondents that marked them as initially important as 11 out of 15 motivations had an average Likert rating of current importance between 4 ("very important") and 5 ("extremely important") (Table 2).

MOTIVATIONS VARY AS PARTICIPATION INTENSITY INCREASES

In accordance with the Likert importance ratings of all respondents, the top motivation, receiving the highest combined percentage of "very" and "extremely" important ratings, among each observation count group was either "Improving my knowledge about species, especially by identifying species I am unfamiliar with" or "Discovering new information about ecosystems where I live"—the two most important motivations among all respondents. While all motivations appear to differ in importance and/or unimportance in some way among different observation count groups (Supplemental file 8: Supplemental Figures 6–10), only four motivations differed significantly by observation count group, based on Chi-squared tests of independence. The Likert ratings for "Contributing to important scientific research and conservation efforts" ($\chi^2(16) = 36.431$, p-value < 0.005), "Gaining recognition and respect from others" ($\chi^2(16) = 42.075$, p-value < 0.005), "Building friendships with other people who enjoy iNaturalist" ($\chi^2(16) = 52.315$, p-value < 0.005), and "Watching my personal metrics on the platform increase as I submit more observations" ($\chi^2(16) = 65.616$, p-value < 0.005) all had a significant relationship with categorical observation count. Science and conservation, friendship building, and personal metrics grew in importance for successive, increasing observation count. In contrast, "recognition," an overall unimportant motivator, had the lowest percent importance from both extremes of observation count groups compared to the other three groups (Figure 2).

Multiple motivations that did not significantly change by observation count group exhibited high overall importance

INITIAL MOTIVATION	NUMBER OF RESPONSES	PROPORTION OF RESPONSES (%)	MEAN LIKERT RATING OF CURRENT IMPORTANCE	TOTAL MEAN LIKERT RATING OF CURRENT IMPORTANCE
Recognition	2	0.47	2.50	1.89
Exercise	11	2.56	4.45	3.28
Friendship	16	3.73	3.81	2.45
Right thing to do	18	4.20	4.94	3.98
Career	22	5.13	4.13	2.22
Personal metrics	26	6.06	3.73	2.48
Protect	39	9.09	4.54	3.88
Connection	46	10.72	4.61	4.06
Request	54	12.59	3.09	2.21
Outside	71	16.55	4.59	4.06
Fun	79	18.41	4.53	4.10
Citizen science	90	20.98	4.67	4.07
Science	157	36.60	4.55	4.11
Discovery	178	41.49	4.56	4.34
Species	309	72.03	4.69	4.54

Table 2 Summary table of initial importance of motivations alongside current importance.

Note(s): The mean Likert rating of current importance is among respondents that found each motivation initially important. The total mean Likert rating of current importance uses responses from all respondents. A "1" rating corresponds to "not at all important" and "5" corresponds to "extremely important."

across all observation count groups (e.g., "Species knowledge"; Figure 1). Among respondents who ranked their top motivations and provided a categorical observation count (93.7% of respondents), the top five motivations were species knowledge, ecosystem discovery, fun, connection, and citizen science (Figure 3). When respondents ranked these motivations against each other, on average, species knowledge was ranked above every other motivation

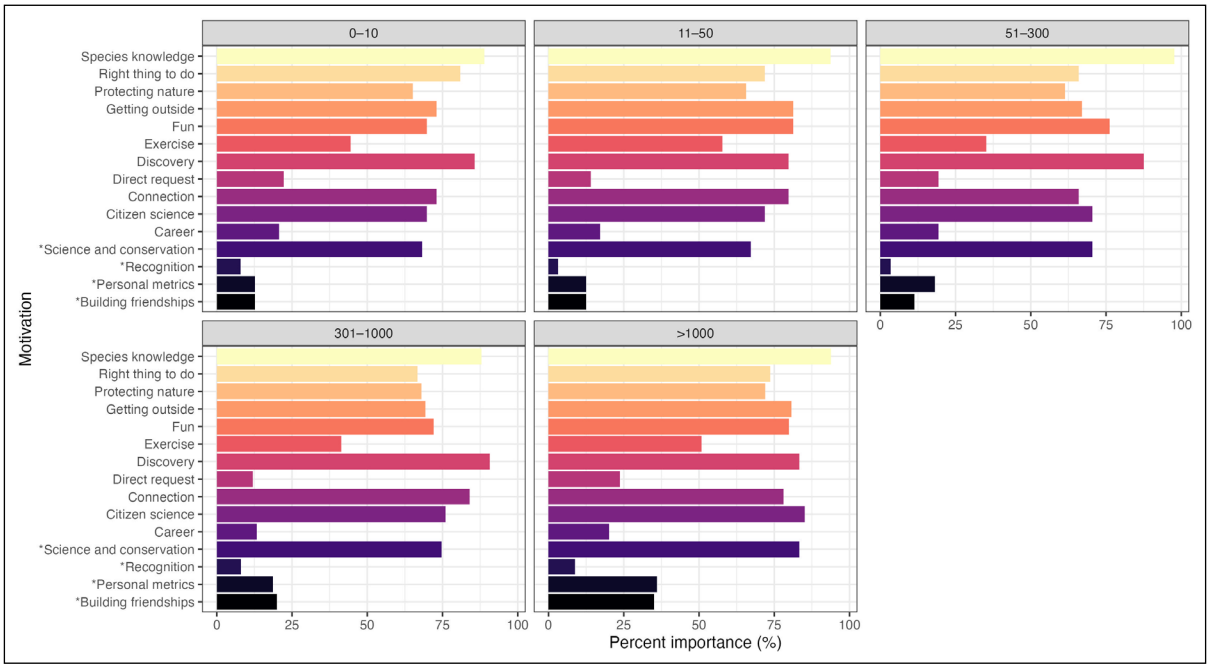

Figure 2 Percent of responses that rated each motivation as "very" or "extremely" important. Responses (n = 404) are grouped by the categorical observation counts of respondents on iNaturalist. Colors correspond to the same motivations across all five groups. Motivations that exhibited a significant relationship ($p < 0.05$) between their importance and observation count group are preceded by an asterisk.

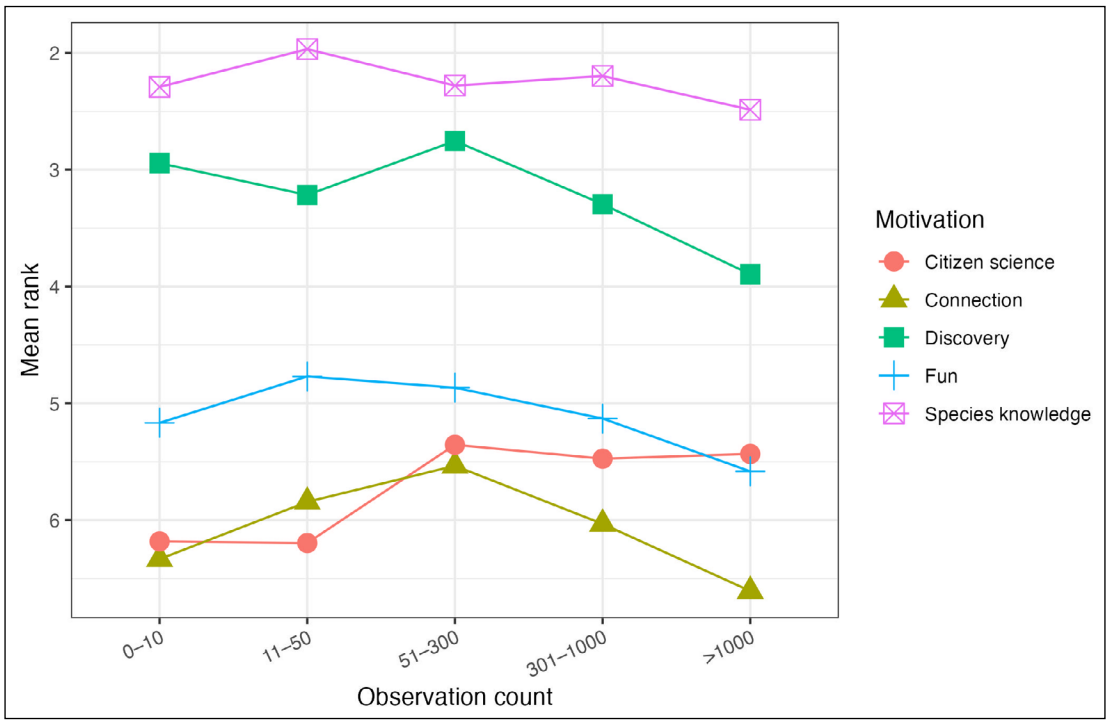

Figure 3 Respondents ranked motivations they marked as "very" or "extremely" important for their use of iNaturalist against each other (with 1 being the most important). The five motivations with the highest percentages of "very" and "extremely" important ratings are shown with their average ranks against other top motivators given by respondents grouped by observation count.

by respondents across all observation count categories. Although below species knowledge, ecosystem discovery was also ranked consistently above other top motivators across all observation count categories. These two motivations received the highest percentage of high-importance Likert ratings and also had the highest mean ranks across all observation groups (Figure 3).

In general, most motivations showed little to no change in Likert rating as continuous observation count increased (Supplemental file 9: Supplemental Figure 11). However, our ordinal regressions revealed that six motivations had statistically significant relationships in which Likert ratings increased with observation count (Figure 4). The six motivations that showed a statistically significant positive change were personal metrics (slope = 0.631, p-value < 0.005), building friendships (slope = 0.46, p-value < 0.005), recognition (slope = 0.432, p-value < 0.005), science and conservation (slope = 0.391, p-value < 0.005), career (slope = 0.228, p-value = 0.027), and citizen science (slope = 0.215, p-value = 0.032). Model estimates for all 15 motivations can be viewed in Supplemental file 10: Supplemental Figure 12.

DISCUSSION

Understanding what drives participation in citizen science is essential for designing effective programs that sustain engagement over time. We found that improving knowledge about species and discovering information about local ecosystems were important among participants, generally agreeing with previous research focused on motivations of citizen science participants (Larson et al. 2020; Bible and Clarke-De Reza 2023; Maund et al. 2020; Bowler et al. 2022; West, Dyke, and Pateman 2021; Bruyere and Rappe 2007; Measham and Barnett 2008; Alender 2016; Asingizwe et al. 2020; Carballo-Cárdenas and Tobi 2016). Improving species knowledge consistently remained a motivation of high importance regardless of participation intensity, highlighting the role of iNaturalist in supporting learning by individuals consistent with the way the platform advertises itself. Six of the fifteen motivations examined showed statistically significant differences among participation levels, indicating that motivations of citizen science participants are dynamic and evolve as engagement with the platform increases. While contributing to science and conservation grew in importance with higher participation, other, more egoistic motivators (Batson, Ahmad, and Stocks 2010) such as increasing personal metrics and building friendships also became more important, suggesting variability in the types of motivations that change as a function of participation. Our findings highlight the importance of examining whether motivations shift over time. Since motivations differ as a function of participation intensity, our results suggest that understanding these shifts is essential to align program benefits with participants' differing priorities, ultimately

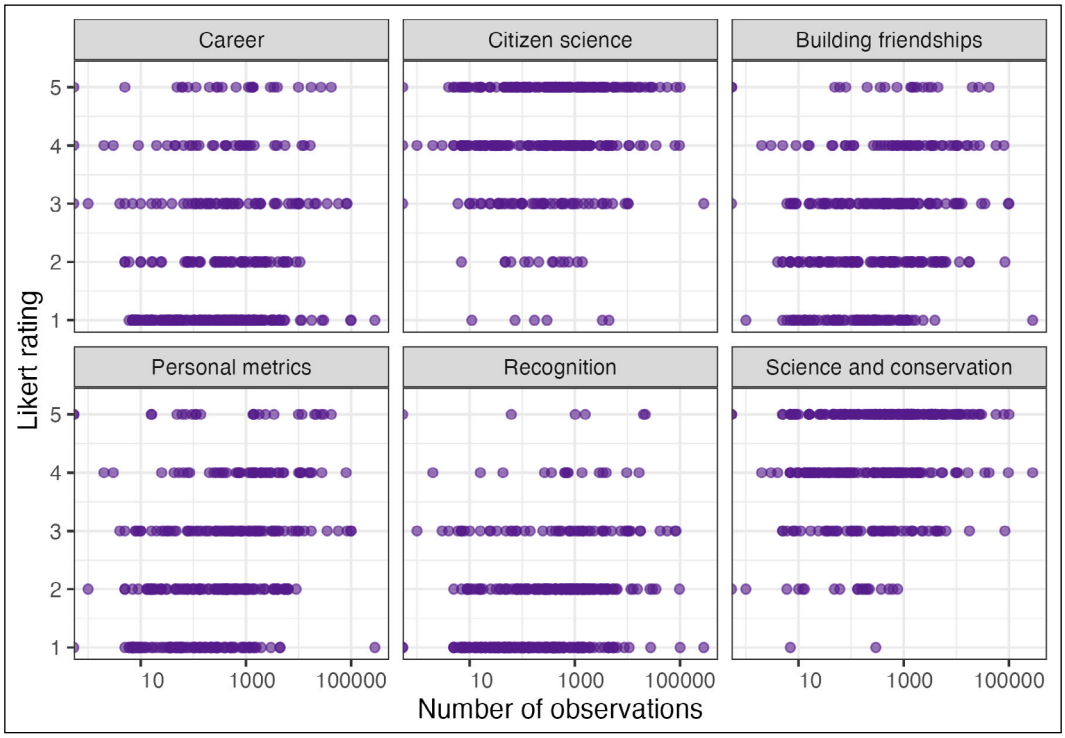

Figure 4 Likert ratings of motivations that had significant relationships with observation count (p-value < 0.05). A "1" corresponds to a rating of "not at all important" and "5" corresponds to "extremely important."

sustaining long-term engagement (Alender 2016; Maund et al. 2020).

An increase in the importance of egoistic motivators as participation level increases contrasts with previous literature about citizen science participation. Participant engagement is expected to shift from being motivated by egoistic motivators to being motivated by collectivistic or altruistic motivators over time (Bible and Clarke-De Reza 2023; Rotman et al. 2012). Among the six motivations that we found increased in importance by observation count, only science and conservation and belief in the importance of citizen science are collectivistic. Friendship building, career advancement, recognition, and personal metrics are all egoistic motivations centered on the individual user experience. Species knowledge and ecosystem discovery, two other egoistic motivations, remained important across all participation levels, further contradicting previous literature which would predict a decline in the importance of these motivations (Rotman et al. 2012; Bible and Clarke-De Reza 2023). Combined, these results signal the importance of egoistic, user-centered motivations in iNaturalist usage. Given how our results contrast with those of others (e.g., Rotman et al. 2012; Bible and Clarke-De Reza 2023), we speculate that variability among citizen science projects in design, structure, and/or recruitment tactics influences the motivations of participants. iNaturalist is unlike other projects in that it is not expressly created to achieve biodiversity-oriented citizen science goals. While the data generated by users may be used to answer a wide range of biological questions, iNaturalist's creation as a "social network" geared at "helping [users] learn about nature" (iNaturalist 2025) sets it apart from other citizen science projects and may help to explain the difference in motivations of iNaturalist users compared with participants of other projects.

Previous research found that contributing to science and conservation efforts is one of the most important motivators among citizen science participants both initially (Larson et al. 2020; Asingizwe et al. 2020) and for current participation (West, Dyke, and Pateman 2021; Bowler et al. 2022). While our study does not find science and conservation to be unimportant, it is not the most important motivation initially or currently for iNaturalist users. Despite this difference, science and conservation does demonstrate increasing importance for continued participation among iNaturalist users, consistent with other research (Larson et al. 2020; Asingizwe et al. 2020). Improving species knowledge is of far greater proportional importance than science and conservation is to iNaturalist users than we originally hypothesized based on previous research (see Table 1), especially amongst high-participation-level users (Bowler et al. 2022; Carballo-Cárdenas and Tobi 2016; Asingizwe et al. 2020). This may be attributed to the capabilities of iNaturalist that allow users to both explore and create observations and identifications. Computer vision–assisted and community-provided identifications of observations create opportunities for users to learn about species they observe while improving identification skills (Hitchcock, Sullivan, and O'Donnell 2021). This creates a greater potential for learning than a more structured citizen science project that would require participants to have certain levels of knowledge prior to participation, and we suggest that the potential for continuous learning correlates with the structure of a citizen science platform. The motivational strength of improving species knowledge coupled with the greater proportion of respondents who rated science and conservation as unimportant may highlight participants' use of iNaturalist as a tool for their own learning (Altrudi 2021) over a mechanism to contribute to science.

This cross-sectional study was designed to provide initial insights into motivational shifts over different stages of platform engagement. Importantly, by sampling over 400 users of iNaturalist, one of the most globally successful citizen science platforms (Callaghan et al. 2022), we were able to include participants with diverse taxonomic interests, participation levels, and observation locations, making our results more generalizable to other, more narrowly focused citizen science projects. Our respondents were slightly younger than typical participants of other citizen science projects (Larson et al. 2020), yet on average older than 22 years old, the median age of all iNaturalist participants (Strasser et al. 2023). While still majority white/Caucasian, our respondents did report above-average diversity of races/ethnicities and exhibited increased gender parity compared with other citizen science projects (Larson et al. 2020). The demographics of our respondents mostly mirror those of iNaturalist users as a whole (Strasser et al. 2023) but differ from other citizen science project participants. This is potentially another factor that contributes to the unique motivations of iNaturalist users.

In our study, we captured the effect of participation intensity on user motivations by studying how the importance of motivations changed across varying observation counts. We recommend that future studies track participants' motivational shifts longitudinally by surveying when participants join, and multiple times throughout their participation. This approach would help control for variation in user engagement frequency, as well as factors like individual development and changes over calendar time. More importantly, it would provide a clearer picture of how participants' opinions evolve, rather than inferring change by comparing different groups who vary in their level of participation. Sampling participants

from small-scale, structured citizen science projects and large-scale, unstructured or semi-structured projects and platforms would provide additional data needed to assess the scope of our results' applicability to projects that differ in structure and size from iNaturalist.

Our results have important implications for citizen science practitioners. In general, we show that new participants are highly motivated by learning about species and the ecosystems around them, suggesting that practitioners should emphasize the learning opportunities their projects provide when recruiting participants. As an example, learning modules have been shown to be an effective method for encouraging secondary recruitment of new participants (Andow et al. 2016), meaning an emphasis on learning could help attract new participants and build a culture among participants that incorporates their participation into the culture of their established communities. While focusing efforts on attracting new participants, practitioners must not neglect participation among existing users. Important and common amongst citizen science platforms are "power users," who are responsible for 80–90% of data collected (Wood et al. 2011; Rowley et al. 2019; August et al. 2020). By understanding what motivates power users, practitioners can maintain and increase the quantity and quality of observations being made (Wood et al. 2011). Our findings indicate that in addition to learning, high-participation-level users are especially motivated by having fun and contributing to science and conservation efforts. Gamification is an example of a fun, effective way to engage users in educational environments (Saleem, Noori, and Ozdamli 2022) and is projected to be a useful tool to incorporate into citizen science projects (Newman et al. 2012; but see Thompson et al. 2023). Points, leaderboards, badges, and levels are all effective engagement tools (Saleem, Noori, and Ozdamli 2022) that may bring an element of fun to a project. Additionally, organized bioblitz events, like the City Nature Challenge, provide an opportunity for users to have fun and have been proven to successfully increase participants' observation activity for months following an event (Meeus et al. 2023). Advertising and incorporating enjoyable elements into data collection, while highlighting the critical role participants' contributions play in scientific endeavors, can be effective strategies for retaining long-term users.

CONCLUSIONS

A primary takeaway from our results is the unparalleled strength of improving species knowledge as a motivator regardless of participation intensity, emphasizing the valuable role iNaturalist is playing in fostering learning opportunities for users. The importance of this and other egoistic motivators highlights that users may contribute observations that help the collective endeavors of science and conservation while being motivated by personal interests. A second takeaway is the intricate shifts in importance of different motivations as a function of participation intensity, with six out of fifteen showing changes. This underscores the value of considering the varied motivations of citizen science participants. Platforms like iNaturalist can harness personal curiosity, provide opportunities to learn about species and the ecosystems they live in, and, in doing so, link individual interests and collective scientific advances.

DATA ACCESSIBILITY STATEMENT

All iNaturalist usernames provided by respondents are removed from data to preserve privacy. Necessary code and anonymized data is archived in the Zenodo repository linked here: https://doi.org/10.5281/zenodo.16760915.

SUPPLEMENTARY FILES

The Supplementary files for this article can be found as follows:

- **Supplemental File 1:** Supplementary Table 1. Motivations cited by literature, found in our survey, and their abbreviations in our manuscript accompanied by results from our study for each motivation. DOI: https://doi.org/10.5334/cstp.823.s1
- **Supplemental File 2:** Appendix 1. Full survey. DOI: https://doi.org/10.5334/cstp.823.s2
- **Supplemental File 3:** Supplemental Figure 1. Respondents' years on iNaturalist and observation counts. DOI: https://doi.org/10.5334/cstp.823.s3
- **Supplemental File 4:** Supplemental Figure 2. Quota sample response rate. DOI: https://doi.org/10.5334/cstp.823.s4
- **Supplemental File 5:** Appendix 2. Full survey in Spanish. DOI: https://doi.org/10.5334/cstp.823.s5
- **Supplemental File 6:** Supplemental Figure 3. Number of survey responses for both sampling methods. DOI: https://doi.org/10.5334/cstp.823.s6
- **Supplemental File 7:** Supplemental Figures 4 and 5. Comparing Likert ratings by sampling method. DOI: https://doi.org/10.5334/cstp.823.s7
- **Supplemental File 8:** Supplemental Figures 6–10. Likert ratings by observation count groups. DOI: https://doi.org/10.5334/cstp.823.s8
- **Supplemental File 9:** Supplemental Figure 11. Likert ratings relationship with continuous observation count for all motivations. DOI: https://doi.org/10.5334/cstp.823.s9

- **Supplemental File 10:** Supplemental Figure 12. Estimated effects of observation count on the importance of each motivation (based on cumulative links models). DOI: https://doi.org/10.5334/cstp.823.s10

ETHICS AND CONSENT

Before beginning the survey, participants were shown a title page that described the purpose of the research being conducted and what their voluntary participation would entail. This page also indicated that all participants were required to be 18 years old or older. Participants gave their informed consent by beginning the survey. We did not collect or access any personal identifiable information about participants such as their email address or name. Data collected through the iNaturalist API was freely available. This survey and research project was conducted with the approval of the Institutional Review Board (IRB) of the University of Florida (Protocol #: ET00022066).

ACKNOWLEDGEMENTS

We thank Victoria McReynolds for translating the survey into Spanish, permitting the creation of the Spanish version of the survey. We are grateful to the iNaturalist team for initial conversations and feedback on potential motivations. CTC acknowledges that this research was supported in part by the intramural research program of the US Department of Agriculture, Hatch, FLA-FTL-006297.

COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS

SKL, BMM, RG, NAM, and CTC contributed to the project conception and design of the survey methodologies. SKL, BMM, and CTC acquired and analyzed data. All authors, led by SKL, drafted sections of the manuscript and critically revised the content. All authors gave final approval of the submitted version and agree to be accountable for aspects of the work they conducted.

AUTHOR AFFILIATIONS

Samantha K. Lowe orcid.org/0009-0006-4672-4698
Graduate Student (MSc), School of Natural Resources and Environment, University of Florida, US; Institute of Food and Agricultural Sciences, University of Florida, US

Brittany M. Mason orcid.org/0000-0002-5325-5686
Department of Wildlife Ecology and Conservation, University of Florida, US; Fort Lauderdale Research and Education Center, University of Florida, US; Institute of Food and Agricultural Sciences, University of Florida, US

Robert Guralnick orcid.org/0000-0001-6682-1504
Florida Museum of Natural History, University of Florida, US; School of Natural Resources and Environment, University of Florida, US

Nia A. Morales orcid.org/0000-0003-3150-7042
Department of Wildlife Ecology and Conservation, University of Florida, US; School of Natural Resources and Environment, University of Florida, US; Institute of Food and Agricultural Sciences, University of Florida, US

Corey T. Callaghan orcid.org/0000-0003-0415-2709
Department of Wildlife Ecology and Conservation, University of Florida, US; Fort Lauderdale Research and Education Center, University of Florida, US; School of Natural Resources and Environment, University of Florida, US; Institute of Food and Agricultural Sciences, University of Florida, US

REFERENCES

Alender, B. (2016) Understanding volunteer motivations to participate in citizen science projects: A Deeper look at water quality monitoring. *Journal of Science Communication*, 15(3), pp. 1–19. DOI: https://doi.org/10.22323/2.15030204

Altrudi, S. (2021) Connecting to nature through tech? The case of the iNaturalist app. *Convergence: The International Journal of Research into New Media Technologies*, 27(1), pp. 124–141. DOI: https://doi.org/10.1177/1354856520933064

Anderson, J.C. and **Moore, L.F.** (1978) The motivation to volunteer. *Journal of Voluntary Action Research*, 7, pp. 120–129. DOI: https://doi.org/10.1177/089976407800700312

Andow, D.A., Borgida, E., Hurley, T.M. and **Williams, A.L.** (2016) Recruitment and retention of volunteers in a citizen science network to detect invasive species on private lands. *Environmental Management*, 58(4), pp. 606–618. DOI: https://doi.org/10.1007/s00267-016-0746-7

Asingizwe, D., Marijn Poortvliet, P., Koenraadt, C.J.M., van Vliet, A.J.H., Ingabire, C.M., Mutesa, L. and **Leeuwis, C.** (2020) Why (not) participate in citizen science? Motivational factors and barriers to participate in a citizen science program for malaria control in Rwanda. *PLoS ONE*, 15(8), pp. 1–25. DOI: https://doi.org/10.1371/journal.pone.0237396

August, T., Fox, R., Roy, D.B. and **Pocock, M.J.O.** (2020) Data-derived metrics describing the behaviour of field-based citizen scientists provide insights for project design and modelling bias. *Scientific Reports*, 10(1), pp. 1–12. DOI: https://doi.org/10.1038/s41598-020-67658-3

Batson, C.D., Ahmad, N. and **Stocks, E.L.** (2010) Four forms of prosocial motivation: Egoism, altruism, collectivism, and

principlism. In D. Dunning (ed.) *Social Motivation*. Psychology Press, pp. 103–126.

Batson, C.D., Ahmad, N. and **Tsang, J.A.** (2002) Four motives for community involvement. *Journal of Social Issues*, 58(3), pp. 429–445. DOI: https://doi.org/10.1111/1540-4560.00269

Bible, J. and **Clarke-De Reza, S.** (2023) Environmental volunteers endorse diverse motivations: Using a mixed-methods study to assess initial and sustained motivation to engage in public participation in science research. *Citizen Science: Theory and Practice*, 8(1), pp. 1–14. DOI: https://doi.org/10.5334/cstp.506

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

Bowler, D.E., Bhandari, N., Repke, L., Beuthner, C., Callaghan, C.T., Eichenberg, D., Henle, K., et al. (2022) Decision-making of citizen scientists when recording species observations. *Scientific Reports*, 12(1), pp. 1–11. DOI: https://doi.org/10.1038/s41598-022-15218-2

Bruyere, B. and **Rappe, S.** (2007) Identifying the motivations of environmental volunteers. *Journal of Environmental Planning and Management*, 50(4), pp. 503–516. DOI: https://doi.org/10.1080/09640560701402034

Callaghan, C. T., Mesaglio, T., Ascher, J. S., Brooks, T. M., Cabras, A. A., Chandler, M., Cornwell, W. K., et al. (2022) The benefits of contributing to the citizen science platform iNaturalist as an identifier. *PLoS Biology*, 20(11), p. e3001843. DOI: https://doi.org/10.1371/journal.pbio.3001843

Carballo-Cárdenas, E.C. and **Tobi, H.** (2016) Citizen science regarding invasive lionfish in Dutch Caribbean MPAs: Drivers and barriers to participation. *Ocean and Coastal Management*, 133, pp. 114–127. DOI: https://doi.org/10.1016/j.ocecoaman.2016.09.014

Christensen, R. (2011) Analysis of ordinal data with cumulative link models—estimation with the R-package ordinal. pp. 1–32. Available at: http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Analysis+of+ordinal+data+with+cumulative+link+models+—+estimation+with+the+R+-package+ordinal#0

Christensen, R. (2023) ordinal-Regression models for ordinal data. R package version 2023.12–4, https://CRAN.R-project.org/package=ordinal.

Di Cecco, G.J., Barve, V., Belitz, M.W., Stucky, B.J., Guralnick, R.P. and **Hurlbert, A.H.** (2021) Observing the observers: How participants contribute data to iNaturalist and implications for biodiversity science. *BioScience*, 71(11), pp. 1179–1188. DOI: https://doi.org/10.1093/biosci/biab093

Dickinson, J.L., Zuckerberg, B. and **Bonter, D.N.** (2010) Citizen science as an ecological research tool: Challenges and benefits. *Annual Review of Ecology, Evolution, and Systematics*, 41, pp. 149–172. DOI: https://doi.org/10.1146/annurev-ecolsys-102209-144636

GBIF.org (15 November 2023) GBIF Occurrence Download. DOI: https://doi.org/10.15468/dl.7vawh2

Göb, R., McCollin, C. and **Ramalhoto, M.F.** (2007) Ordinal methodology in the analysis of Likert scales. *Quality and Quantity*, 41(5), pp. 601–626. DOI: https://doi.org/10.1007/s11135-007-9089-z

Hitchcock, C., Sullivan, J. and **O'Donnell, K.** (2021) Cultivating bioliteracy, biodiscovery, data literacy, and ecological monitoring in undergraduate courses with iNaturalist. *Citizen Science: Theory and Practice*, 6(1), pp. 1–13. DOI: https://doi.org/10.5334/CSTP.439

iNaturalist. (2024a). Observations. Available at: https://www.inaturalist.org/observations [Last accessed: 17 November, 2024].

iNaturalist. (2024b) Archived help page. Available at: https://www.inaturalist.org/pages/archived+help#quality [Last accessed: 4 November 2024].

iNaturalist. (2025) About. Available at https://www.inaturalist.org/pages/about [Last accessed: 30 May 2025].

Ives, A.R. (2015) For testing the significance of regression coefficients, go ahead and log-transform count data. *Methods in Ecology and Evolution*, 6(7), pp. 828–835. DOI: https://doi.org/10.1111/2041-210X.12386.

Jordan, R., Crall, A., Gray, S., Phillips, T. and **Mellor, D.** (2015) Citizen science as a distinct field of inquiry. *BioScience*, 65(2), pp. 208–211. DOI: https://doi.org/10.1093/biosci/biu217

Land-Zandstra, A., Agnello, G. and **Gültekin, Y.S.** (2021) Participants in citizen science. In: Vohland, K., et al. (eds.) *The Science of Citizen Science*. Springer, Cham. pp. 243–259. DOI: https://doi.org/10.1007/978-3-030-58278-4_13

Larson, L.R., Cooper, C.B., Futch, S., Singh, D., Shipley, N.J., Dale, K., LeBaron, G.S. et al. (2020) The diverse motivations of citizen scientists: Does conservation emphasis grow as volunteer participation progresses?. *Biological Conservation*, 242, p. 108428. DOI: https://doi.org/10.1016/j.biocon.2020.108428

Loarie, S. (2024) iNatBlog, 3 April 2024. Available at https://www.inaturalist.org/blog/archives/2024/04 [Last accessed 4 November 2024].

Maund, P.R., Irvine, K.N., Lawson, B., Steadman, J., Risely, K., Cunningham, A.A. and **Davies, Z.G.** (2020) What motivates the masses: Understanding why people contribute to conservation citizen science projects. *Biological Conservation*, 246(March), p. 108587. DOI: https://doi.org/10.1016/j.biocon.2020.108587

Measham, T.G. and **Barnett, G.B.** (2008) Environmental volunteering: Motivations, modes and outcomes. *Australian Geographer*, 39(4), pp. 537–552. DOI: https://doi.org/10.1080/00049180802419237

Meeus, S., Silva-Rocha, I., Adriaens, T., Brown, P.M.J., Chartosia, N., Claramunt-López, B., Martinou, A.F., et al. (2023) More than a bit of fun: The multiple outcomes of a bioblitz. *BioScience*, 73(3), pp. 168–181. DOI: https://doi.org/10.1093/biosci/biac100

Msuha, B. and **Mdendemi, T.** (2019) Hypothesis testing for the association between categorical variables: Empirical application of Chi-square test. *Mathematical Theory and Modeling*, 9(2), pp. 9–17. DOI: https://doi.org/10.7176/MTM

Newman, G., Wiggins, A., Crall, A., Graham, E., Newman, S., Crowston, K. (2012) The future of citizen science: Emerging technologies and shifting paradigms. *Frontiers in Ecology and the Environment*, 10(6), pp. 298–304. DOI: https://doi.org/10.1890/110294

Nguyen, M. and **Tran, A.** (2023) Motivational factors underpinning long-term engagement of citizen scientists in biodiversity conservation. *Journal of Sustainable Urban Futures*, 13(9), pp. 25–37.

Piedmont, R.L. (2014). Inter-item correlations. In: Michalos, A.C. (ed.) *Encyclopedia of Quality of Life and Well-Being Research*. Springer, Dordrecht. DOI: https://doi.org/10.1007/978-94-007-0753-5_1493

Pocock, M.J.O., Tweddle, J.C., Savage, J., Robinson, L.D. and **Roy, H.E.** (2017) The diversity and evolution of ecological and environmental citizen science. *PLoS ONE*, 12(4), pp. 1–17. DOI: https://doi.org/10.1371/journal.pone.0172579

R Core Team (2024) R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Available at: https://www.R-project.org/

Rotman, D., Preece, J., Hammock, J., Procita, K., Hansen, D., Parr, C., Lewis, D., et al. (2012) Dynamic changes in motivation in collaborative citizen-science projects. In: *Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work*, Seattle, WA on 11–15 February 2012, pp. 217–226. DOI: https://doi.org/10.1145/2145204.2145238

Rowley, J.J.L., Callaghan, C.T., Cutajar, T., Portway, C., Potter, K., Mahony, S., Trembath, D.F., et al. (2019) FrogID: Citizen scientists provide validated biodiversity data on frogs of Australia. *Herpetological Conservation and Biology*, 14(1), pp. 155–170.

Saleem, A.N., Noori, N.M., and **Ozdamli, F.** (2022) Gamification applications in e-learning: A literature review. *Technology, Knowledge and Learning*, 27, pp.139–159. DOI: https://doi.org/10.1007/s10758-020-09487-x

Sbrocchi, C.D. (2014) *Evaluating the usefulness of citizen science for natural resource management in marine environments*. Unpublished thesis (M.S.), University of Technology Sydney.

Sedgwick, P. (2012) Pearson's correlation coefficient. *BMJ (Online)*, 345(7864), pp. 1–2. DOI: https://doi.org/10.1136/bmj.e4483

Soteropoulos, D.L., De Bellis, C.R. and **Witsell, T.** (2021) Citizen science contributions to address biodiversity loss and conservation planning in a rapidly developing region. *Diversity*, 13(6), pp. 1–14. DOI: https://doi.org/10.3390/d13060255

Strasser, B.J., Tancoigne, E., Baudry, J., Piguet, S., Spiers, H., Luis-Fernandez Marquez, J., Kasparian, J., et al. (2023) Quantifying online citizen science: Dynamics and demographics of public participation in science. *PLoS ONE*, 18(11), p. e0293289. DOI: https://doi.org/10.1371/journal.pone.0293289

Thompson, M.M., Moon, K., Woods, A., Rowley, J.J.L., Poore, A.G.B., Kingsford, R.T. and **Callaghan, C.T.** (2023) Citizen science participant motivations and behaviour: Implications for biodiversity data coverage. *Biological Conservation*, 282(April), p. 110079. DOI: https://doi.org/10.1016/j.biocon.2023.110079

United States Census Bureau (USCB). (2022) B16001: Language spoken at home by ability to speak English for the population 5 years and over. Available at https://data.census.gov/table/ACSDT1Y2022.B16001?q=B16001:+Language+Spoken+at+Home+by+Ability+to+Speak+English+for+the+Population+5+Years+and+Over [Last accessed 4 November 2024].

West, S., Dyke, A. and **Pateman, R.** (2021) Variations in the motivations of environmental citizen scientists. *Citizen Science: Theory and Practice*, 6(1), pp. 1–18. DOI: https://doi.org/10.5334/cstp.370

Wood, C., Sullivan, B., Iliff, M., Fink, D. and **Kelling, S.** (2011) eBird: Engaging birders in science and conservation. *PLoS Biology*, 9(12), p. e1001220. DOI: https://doi.org/10.1371/journal.pbio.1001220

TO CITE THIS ARTICLE:
Lowe, S.K., Mason, B.M., Guralnick, R., Morales, N.A. and Callaghan, C.T. 2025. Participation Intensity Influences Motivations for Contributing to iNaturalist. *Citizen Science: Theory and Practice,* 10(1): 25, pp. 1–15. DOI: https://doi.org/10.5334/cstp.823

Submitted: 06 December 2024 **Accepted:** 16 July 2025 **Published:** 14 August 2025