Title: Connecting youth and wildlife in India: the benefits of citizen science in the classroom

Authors:

Bella Insignares, Department of Forestry and Environmental Resources, NC State University, Raleigh, NC, USA 27695; iminsign@alumni.ncsu.edu

Lincoln Larson, Department of Parks, Recreation, and Tourism Management, NC State University, Raleigh, NC, USA 27695; LRLarson@ncsu.edu

Kathryn Stevenson, Department of Parks, Recreation, and Tourism Management, NC State University, Raleigh, NC, USA 27695; ktate@ncsu.edu

Lara Pacifici, Department of Forestry and Environmental Resources, NC State University, Raleigh, NC, USA 27695; lara_pacifici@ncsu.edu

Hannah Williams, College of Natural Resources, NC State University, Raleigh, NC, USA 27695; hewilli6@ncsu.edu

Stephanie Manka Schuttler, TBD, stephanie.schuttler@gmail.com

Roland Kays, Department of Forestry & Environmental Resources, NC State University, Raleigh, NC, USA 27695; rwkays@ncsu.edu

Rahul Khot, Bombay Natural History Society, Mumbai, India; rahul.bnhs@gmail.com

Acknowledgments:
This research was supported by funding from NSF 1539622 and NSF 1319293, VWR Corporation, Museums Connect Grant from the American Alliance of Museums, US Department of State, and Bureau of Educational and Cultural Affairs.

Abstract (150 word limit)

Young people represent the future of wildlife conservation, but little is known about their perceptions of wildlife or how activities such as citizen science might impact those perceptions. This gap is particularly pronounced in countries of the Global South. We surveyed 656 adolescent youth across 20 schools in Maharashtra, India, before and after participating in a citizen science project using camera traps to survey wildlife. Indian youth displayed strong mutualistic values, high levels of wildlife affinity and awareness, and strong belief about potential coexistence between humans and wildlife. However, scores for these variables decreased as students' age increased. The citizen science intervention mitigated some of these declines - regardless of students' level of participation in the project. Overall,

results highlight the potential power of citizen science as an educational tool and underscore the need for more research on youth's relationship with wildlife in Global South countries.

As a global biodiversity crisis fueled by human population growth and resource consumption threatens the planet, public understanding of and support for conservation measures is critical (Driscoll et al., 2018; Novacek, 2008). Conservation initiatives that fail to engage the public and garner public approval may be ignored or actively undermined, or worse - they may increase conflicts between humans and wildlife (Peterson et al., 2002). Decades of research on conservation education outcomes has explored public perceptions of wildlife (Ardoin et al., 2020), but less is known about one key stakeholder group with a unique capacity to shape the future of conservation -- youth.

An enhanced knowledge and understanding of youth perceptions of wildlife is valuable for several reasons. First, young people may have an inherent affinity for nature (i.e., biophilia) that is believed to be altered by their environments and can wane over time (Kahn, 1997; Woods and Knuth, 2023). Several shifts in perceptions towards wildlife and nature occur over the course of a young person's development (Kellert, 1985), including an "adolescent dip" of decreasing affinity towards nature and lessened time spent in direct interaction with nature and the outdoors around age 11 onward. (Keith et al., 2021; Larson et al., 2011; Richardson et al., 2019). It is therefore important to understand how to leverage and sustain youth connections to nature at different life stages. Second, young people can act as a link between scientists and the public, enabling intergenerational learning (Ostermann-Miyashita et al., 2021). Youth views and behaviors can shape those of their parents, particularly where other intervention strategies fail (Duvall and Zint, 2007; Marchini and Macdonald, 2020; Peterson et al., 2019). Formal school activities can also be harnessed to involve parents and increase adults' awareness of ecological issues (Marchini and Macdonald, 2020). Third, youth represent a key developmental stage where perceptions and stewardship intentions can be influenced by direct engagement with science and the environment (Ballard et al., 2017). Finally, young people are the beneficiaries of current conservation efforts, and will someday inherit the responsibilities we carry today (Rana et al., 2020; Weiss, 1990). While their perspectives are often neglected, in part due to the colonial legacy of conservation science (Jagadeesh, 2024; Rana et al., 2020), youth will be directly impacted - positively and negatively - by today's management choices, so they should have a say in those management decisions.

Relationship between youth and wildlife: a global perspective

Although research on youth perspectives regarding wildlife is somewhat limited, previous research has shown that youth often have strong emotional connections to nature (broadly) and wildlife (specifically). Affective and emotional connections to animals may be strongest in children ages 7-10 years (Kellert, 1985). Biophilic temperament towards nature is also thought to manifest at a young age (Woods and Knuth, 2023), although changing social and ecological contexts seems to be influencing children's connection to nature and fueling an "extinction of experience" (Louv, 2008; Soga et al., 2016). Declines in nature connection and affinity have been linked to increased screen time, particularly for rural youths, females, and youth of color in the United States (Larson et al., 2019), and affective disconnection to local fauna has been observed in American youth across rural-urban gradients (Schuttler et al., 2019b). While insightful, these findings reveal key understudied gaps in our understanding of youth perceptions on wildlife.

One particularly noticeable gap is the absence of research on the youth-wildlife relationship outside of Global Northern contexts, reflecting the roots of conservation sciences in colonial practices (Jagadeesh, 2024). This absence enables dispossession, and the exclusion of youth from studies also robs this key population of authority on conservation issues (Jagadeesh, 2024). A few notable exceptions include studies in India (Salazar et al., 2021; Salazar et al., 2024), the Bahamas (Shapiro et al., 2016), Latin America (Liles et al., 2021; Muñoz-Pacheco et al., 2024; Rosalino et al., 2017), and Africa (Panisi et al., 2022). Evidence suggests there may be differences in adults' wildlife-related values and attitudes across cultures (Jacobs et al., 2022); perhaps the same is true for youth. These differences could manifest in emotions towards animals, such as in the Biological preparedness hypothesis, which posits that fears of wildlife are related to cultural history with wildlife species (Prokop et al., 2009), as well as in language used to describe human-animal relationships (Cho et al., 2020; Yeshey et al., 2023). Measurement challenges are also present. Survey instruments used to assess attitudes towards wildlife might be difficult for participants to meaningfully respond to if concepts are not culturally relevant or have not been adequately translated, especially if those participants are children (Kuhar et al., 2007). Additionally, the theoretical grounds and tools to understand attitudes towards wildlife have emerged from the context of Western individualism, whereas many populations across the Global South belong to collectivist cultures, which may produce unanticipated effects on survey results (Kellert, 1985; Peterson et al., 2019). For example, Salazar et al. (2021) observed that Indian youth were aware of the opinions of their peers and often copied from their neighbors while completing surveys, reflecting a hesitance to diverge from the group that was attributed to collectivism. In addition to this culturally-mediated reference bias (Lira et al., 2022), social desirability bias also comes into play in classroom settings when power dynamics between teachers, researchers, and students are present - particularly in international research contexts (Lavidas et al., 2022). Because the biodiversity crisis is a global issue, and because mainstream conservation has historically excluded the perspectives of youth, particularly those from the Global South, more international research on the relationship between youth and wildlife is needed (Jagadeesh, 2024).

Measuring youths' relationship with wildlife

There are many different ways to measure the relationship between youth and wildlife. In this study, we focus on three commonly-utilized constructs to better understand that relationship: wildlife value orientations, species attribute preferences, and connection to nature/wildlife.

Wildlife Value Orientations

Wildlife value orientations (WVOs) are defined by Jacobs et al. (2022) as "patterns of basic beliefs that give meaning and direction to fundamental values in the context of human-wildlife relationships" (p.758). WVOs present at the individual level as a general ideology and coalesce at the societal level as culture-wide ideologies (Jacobs et al., 2022). While WVOs are a relatively abstract social construct, they can help managers predict how different stakeholder groups might behave in wildlife-related contexts (KC et al., 2022). Most research on WVOs focused on two key dimensions: beliefs that wildlife are resources available for human use (domination), or beliefs that humans and wildlife are equals in a broader socio-ecological community (mutualism) (Manfredo et al., 2021b). Measuring

dominionistic and mutualistic wildlife value orientations typically involves survey items focusing on hunting beliefs, appropriate use beliefs, social affiliation beliefs, and caring beliefs (Jacobs et al., 2022; Teel and Manfredo, 2010). It is important to note that WVOs do not exist on a mutually exclusive spectrum. Some people might be found to favor either mutualism or domination orientations, but many others are "pluralists" that score high on measures for both orientations; some may also present as "distanced", scoring low on both orientations (Teel and Manfredo, 2010).

Although studies of WVOs are increasingly being integrated into wildlife management and decision making in places such as the USA (Manfredo et al., 2021a) and Europe (Gamborg and Jensen, 2016), it is not yet clear how this framework meshes with diverse cultures (Jacobs et al., 2022). Diverse religious belief systems have been observed to influence WVOs, including those outside of Christianity (Yeshey et al., 2023). It has been hypothesized that values in industrializing countries "shift" away from domination and towards mutualism as urbanization progresses and people come into less direct contact with wildlife (Manfredo et al., 2021b), but more research is needed to support these assertions. Furthermore, little research in any geographic locale has explored the WVOs of youth - a critical gap for reasons described above. One notable exception is Rosalino et al. (2017), which evaluated how youth in Brazil and Portugal prioritized conservation in relation to more human-centric values; while they did not explicitly name the WVO framework in their methodology, the exploration of youth valuation of wildlife conservation is a promising parallel. In our study, we explored youth WVOs and also incorporated a question assessing the extent to which participants believed in the potential for coexistence between humans and wildlife, a concept of growing interest in wildlife management (Pooley et al., 2021).

Species Attribute Preferences

Species attribute preferences (SAPs), which describe the kind of wildlife traits that are favored by humans in the context of wildlife conservation (Frew et al., 2016; Shapiro et al., 2016), are another construct that can help to illuminate people's relationship with wildlife. SAPs directly assess conservation priorities, thus representing valuable information for decision makers seeking to align their projects with local interests (Shapiro et al., 2016). Studies of SAPs have typically focused on five attributes: endemism, utilitarian value, rapid decline, charisma, and ecological significance (Frew et al., 2016; Shapiro et al., 2016). Preferences are assessed by asking participants to rank attributes based on their personal perception of importance to conservation (Liles et al., 2021; Shapiro et al., 2016). Participants might alternatively be asked to name a species of high personal conservation priority out of a set and explain their reasoning, or to choose two attributes that make a species "more prone to be conserved" (Panisi et al., 2022; Rosalino et al., 2017). SAPs can also be used to make inferences about cultural wildlife value orientations (particularly utilitarian beliefs) or the presence of potential "nativism," favoritism for endemic species based on cultural identity (Shapiro et al., 2017). The native/invasive species dichotomy has been criticized for being constructed on human-centric foundations and spurring reactionary sentiments around human immigration (Inglis, 2020); thus, identifying and evaluating nativism through SAPs may also reveal insights on human perspectives applicable beyond just wildlife.

Although interest in SAPs is growing, demographic correlates of these preferences remain relatively unknown - particularly among youth. For example, Frew et al. (2016) and Liles et al. (2021) did not find gender effects on species preferences. Shapiro et al. (2017) found boys ranked utilitarian

species (species you could hunt or fish for) as more important for protection than girls did. Research also suggests that SAPs are not static and change over time in response to education and other factors. For instance, youth participants in an environmental education program focused on biodiversity conservation in the Bahamas prioritized rapidly decreasing species over students who did not participate in the program (Shapiro et al., 2016). More research is needed to identify intervention strategies that can help to transform children's relationship with wildlife.

Connection to Wildlife

Connectedness to nature scales tap into the affective and experiential dimensions of sentiments towards nature (Cheng and Monroe, 2012; Nisbet and Zelenski, 2013; Richardson et al., 2019). Such scales were initially developed for use with adults, but have been simplified to work with youth and measure changes in nature affinity over the course of adolescence (Bowers et al., 2021; Cheng and Monroe, 2012; Nisbet and Zelenski, 2013; Richardson et al., 2019). At their core, connection to nature scales measure enjoyment of nature, empathy for its creatures, sense of oneness with nature, and sense of responsibility to nature (Cheng and Monroe, 2012). Variations include environmental perceptions scales that are often used with children to evaluate affinity to nature. For example, the CEPS (Children's Environmental Perceptions Scale) incorporates the cognitive dimension of nature connections, evaluating young people's grasp of environmental issues and ecosystem processes (Larson et al., 2010a). While connection to nature scales abound, fewer studies have examined specific connections to wildlife, ranging from the early work of Stephen Kellert (1985) to more recent research focused on zoos (Skibins and Powell, 2013). Additionally, review articles reveal that most work focused on human-nature connections has been conducted in the Global North, underscoring the need for research in other geographical contexts (Soga and Gaston, 2023; Whitburn et al., 2020). Furthermore, there is not sufficient evidence to explain the factors associated with these affective connections in youth, and whether they are influenced by things such as screen time (vs. outdoor time; Larson et al., 2019) or specific types of recreational activities (Szczytko et al., 2020). In this study, we used survey items adapted from both connectedness to nature and environmental perceptions scales to focus on youth perspectives of wildlife in an international context, with a particular interest in how it might be influenced by an educational intervention.

Citizen science: an educational tool for connecting youth and wildlife

Citizen science, which emphasizes public participation in scientific research and is sometimes referenced by other names (e.g., community science), is one tool that could be used to influence youth's wildlife-related beliefs, attitudes, and behaviors. Citizen science offers multiple benefits for conservation. Using approaches such as crowdsourcing, citizen science can vastly enlarge the scale at which conservation projects can operate, in both time and space, as well as enabling the opportunistic collection of data during unusual events (McKinley et al., 2017). Citizen science can be more cost-effective than traditional data collection measures, particularly at larger scales (McKinley et al., 2017). Citizen science has also been identified as an outlet to mitigate conflicts in conservation (Newman et al., 2017; Ostermann-Miyashita et al., 2021), particularly in areas where expansions of human settlements and economic sites can put people at odds with wildlife (Chang'a et al., 2016; Larson et al., 2016). When

members of the public are involved in participatory citizen science, this can promote mutual understanding between stakeholder groups and facilitate an enhanced understanding of complex ecological issues (Ostermann-Miyashita et al., 2021; Peterson et al., 2002).

In addition to these direct conservation benefits, citizen science also generates a variety of positive learning outcomes for the people who participate, including youth (Ballard et al., 2017; Peter et al., 2019; Phillips et al., 2019; Schuttler et al., 2018). Involving the public in citizen science can foster engagement in local issues and promote pro-conservation behavior and advocacy (McKinley et al., 2017). Field learning experiences, like those associated with citizen science data collection, can also help to combat animal phobias, thereby mitigating fears of wildlife (Prokop et al., 2010). In youth-specific contexts, citizen science has the potential to be entertaining and exciting, catalyzing an emotional connection with wildlife and nature (Schuttler et al., 2018). Productive learning environments are created when children enjoy a task and perceive a valid sense of purpose; when young people collect data for a citizen science project, both are often accomplished (Bernd and Nitz, 2023; Bird et al., 2023; Larson et al., 2010a; Schuttler et al., 2019a). Citizen science can also be deployed to grant youth agency in the face of perceived powerlessness, supporting decision-making skills and fostering the development of active citizenship (Ballard et al., 2017). The learning process embedded in citizen science has the capacity to enhance youth scientific literacy (Ballard et al., 2017), just as it can for adults (Cronje et al., 2011). Depending on the objectives of the given program, there is also the opportunity to increase vocational literacy, helping young people determine their future career (Pitt and Schultz, 2018).

Despite citizen science's great potential to advance conservation goals by fostering stronger relationships between youth and wildlife, formal assessments of its effects are rare - particularly in school settings (Soanes et al., 2020). The level of citizen science participation needed to make a significant positive effect is also unclear; Bernd and Nitz (2023) suggest motivation and consistency may be more influential in positive effects than levels of participation. Additionally, most case studies of citizen science originate in the US and Europe, failing to account for the rest of the world (Ostermann-Miyashita et al., 2021). Our study was designed to address all of the key research gaps described above by studying the impacts of participation in a wildlife-focused citizen science project on middle school-aged youth in India. Our investigation focused on two key research questions:

1. What do youth in India think about wildlife, measured in terms of their wildlife value orientations, species attribute preferences, and connections to wildlife, and how do these perceptions vary by gender and age?

2. How does participation in a citizen science project affect youth perceptions of wildlife in India, and do impacts vary based on levels of participation, gender and age?

METHODS

Study Area & Participants

Our study used data collected from middle school students in India to investigate youth perceptions of wildlife and how those perceptions were affected by varying levels of participation in the eMammal citizen science project. The study was linked to a larger international project involving schools and classrooms across multiple countries (Schuttler et al., 2019a). Students used the eMammal camera trap data management platform to study the mammal biodiversity in their community following pre-specified protocols to ensure that all data collected were "research grade" (Schuttler et al., 2019a). Participating teachers had access to a curriculum guide and sample lesson plans developed by partners at the NC Museum of Natural Sciences (Appendix A, eMammal International Lesson Plan). From 2014-2016, some of the teachers involved in the project participated in a 3-week training internship with scientists at the NC Museum of Natural Sciences to collaboratively develop lesson plans associated with the project. In addition to refining the education curriculum linked to the project, teachers were also trained in camera trap protocols and encouraged to engage their students in all aspects of the research (Schuttler et al., 2019a).

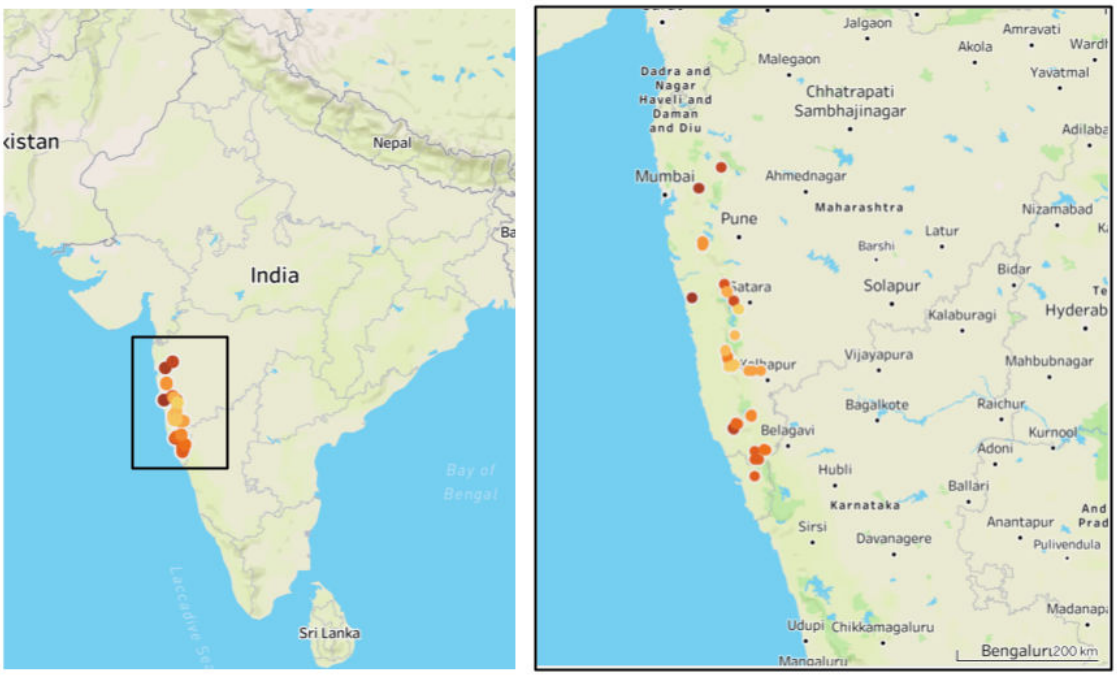

Figure 1. Map of study schools in Maharashtra, India.

Participating teachers were recruited through the Bombay Natural History Society. Ultimately, 20 different schools participated in the project, all located along the coastline of India within the state of Maharashtra (Figure 1). The state of Maharashtra is both culturally and ecologically diverse, and includes a range of biodiversity hotspots and varying degrees of interaction between humans and wildlife. A total of 1448 students participated in the study. The ratio of students per teacher ranged from 25 to 134 students, with students ranging in age from 10-18. However, most students were either age 12 (15.0%), 13 (44.6%), 14 (26.8%), or 15 (9.0%), with just 4.5% falling out of that range. The project was approved by the human subjects review board at NC State University prior to implementation (IRB Protocol 5499, Assurance number FWA00003429).

During project implementation, which stretched from April 2017 to September 2018 for pre-project data collection and November to December 2018 for post-project data collection, teachers ran camera traps for at least one deployment (2-4 weeks in one place around the school site). There were 140 total deployments across all schools, with the least being 2 and the greatest being 21 (Appendix B, Deployments List). Some teachers continuously ran camera traps for multiple months throughout the year. Teachers and students uploaded photos and identified species using customized eMammal software. All photos were later reviewed by wildlife experts to ensure correct species identification. All images and data are available in the Wildlife Insights data repository (Malleshappa et al., 2000)

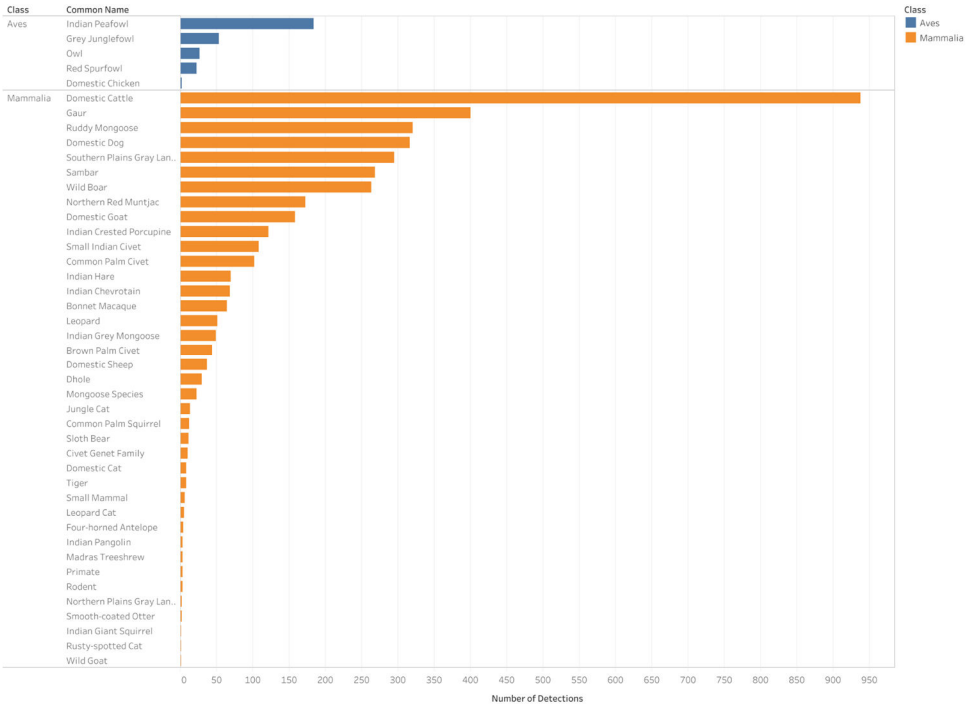

Figure 2. Species detections by students across the entire sample.

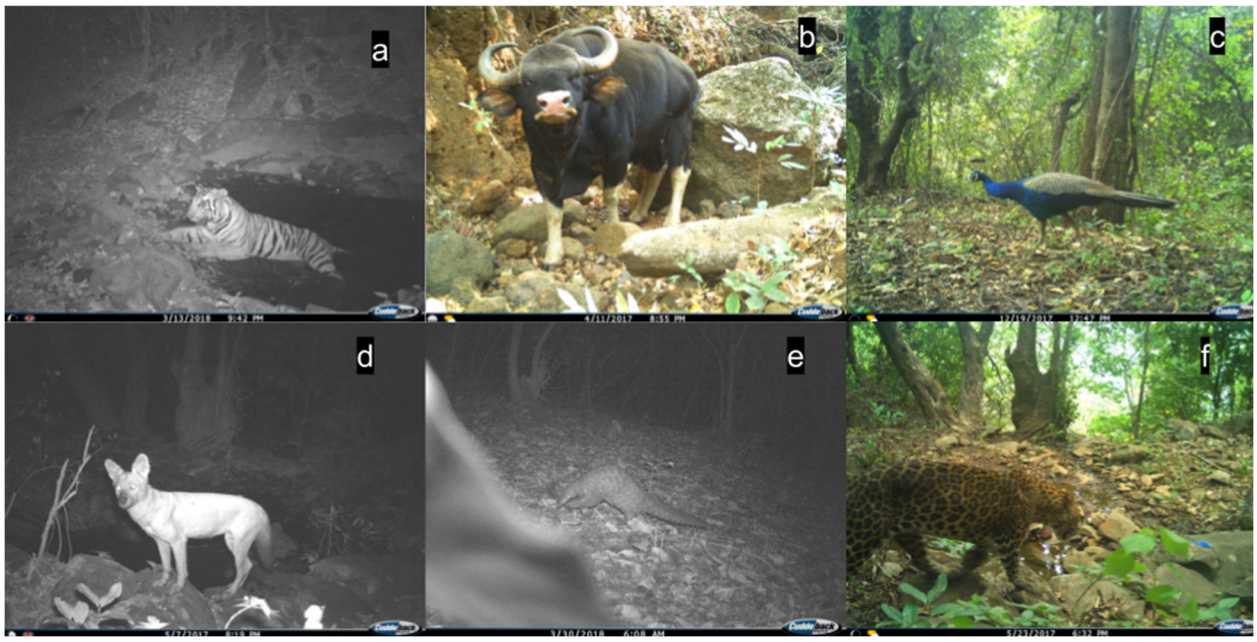

Figure 3. Wildlife species detected across the camera traps in Maharashtra, India, included (a) tigers, (b) gaurs, (c) peacocks, (d) dholes, (e) Indian pangolins, and (f) leopards.

The students in India detected 39 mammal species (Figure 2), which were dominated by herbivores, but also included large predators, such as tigers (*Panthera tigris*), dholes (*Cuon alpinus*), and leopards (*Panthera pardus*). Other wildlife species detected by the students included gaur (*Bos gaurus*), jungle cat (*Felis chaus*), and Indian pangolin (*Manis crassicaudata*).

Survey Instruments

We collected data using pre-project and post-project surveys. Surveys contained identical items designed to measure three key aspects of youths' relationship with wildlife: wildlife value orientations, species attribute preferences, and connection to wildlife. Pre-project surveys also included demographic questions (gender, age). Post-project surveys included a few additional questions about participation in the citizen science program itself (see below).

Wildlife value orientations

We assessed wildlife value orientations using six items taken from Teel and Manfredo (2010), focusing on human use of wildlife (domination) and personal connection to wildlife (mutualism). An example domination item was "The needs of people are more important than the needs of animals", and an example mutualism item was: "I view people and animals as part of one big family". While this scale has primarily been used with adults in past research (Manfredo et al., 2020), some research has shown that it can be effectively employed to measure young people's beliefs about wildlife, too (Clark et al., 2017). Each of these items was rated on a 5-point Likert scale from "strongly disagree" (1) to "strongly agree" (5) with a midpoint of "not sure" (3). We also included two questions about beliefs about peaceful coexistence with wildlife, an understudied concept of increasing importance in the conservation world (Pooley et al., 2021), using the same 5-point Likert scale as the WVO questions. An example of a coexistence item was: "People and wild animals can live happily together in the same place".

Species attribute preferences

We measured the attributes associated with wildlife populations that are most valued by youth using items taken from Frew et al. (2016). Students were asked to rate five attributes with a score of 1 to 5, with 1 representing "a kind of wild animal that should be protected first", and 5 being "a kind of wild animal that should be protected last". We assessed the attributes of charisma ("Wild animals that people like to watch"), utilitarian value ("Wild animals that people like to eat"), endemism ("Wild animals that live nowhere else except for the area where I live"), rapid decline ("Wild animals who numbers are going down fast"), and importance to nature ("Wild animals that are important in nature"). This approach has been used in past research contexts with both adults (Meuser et al., 2009) and youth (Frew et al., 2016; Liles et al., 2021; Shapiro et al., 2016).

Connection to Wildlife

We measured connection to wildlife by presenting students with statements adapted from the Children's Environmental Perceptions Scale (Larson et al., 2009), with additional ideas from Nisbet et al.'s (2009) Nature-relatedness Scale and Franz and Mayer's (2004) Connection to Nature scale. Three items assessed wildlife affinity (derived from eco-affinity in CEPS), and three items assessed wildlife-awareness (derived from eco-awareness in CEPS). The statements were altered from being about "nature" in general to "wildlife" specifically. One example of an affinity item is the statement "I like to spend time in places where wild animals live"; one example of an awareness item is the statement "wild animals are important to people". Students were instructed to indicate how much they agreed with the statements on a 5-point Likert scale from "strongly disagree" (1) to "strongly agree" (5) with a midpoint of "not sure" (3).

Citizen Science Program Participation

We measured citizen science program participation, and its potential impacts, in several ways on the post-test. After answering all identical survey items from the pre-test, students were instructed to check all activities that they did as part of the project such as: "Setting up the camera near your school", "Viewing pictures of wild animals near your school", "Viewing pictures of wild animals taken by kids at other schools", and "Talking with kids at other schools". We used their responses to approximate level of participation (see results). Students were then asked if their experience participating in the project changed their views on a series of items, which they could indicate "decreased a lot" (0), "decreased" (1) "did not change" (2), "increased" (3), or "increased a lot" (4); these answers were recoded in analysis onto a -2 to +2 scale. The potential things that might have changed were: "My interest in wild animals", "My connection to animals and nature", "My knowledge about wild animals in my local area", and "My desire to protect wild animals in my local area". Finally, we asked students two open-ended questions to get a sense of how they perceived the citizen science project and what they learned. These questions were "What was your favorite part about the eMammal project?" and "What is one thing you learned from the eMammal project?".

Data Analysis

Prior to analysis, we examined the dimensionality of the wildlife perceptions scales adapted from previous research (e.g., wildlife value orientations, coexistence with wildlife, connection to wildlife). We did this using principal components analysis with Varimax rotation to assess construct validity, and Cronbach's alpha to assess reliability of responses (Vaske, 2019). We removed items that either (a) cross-loaded on multiple dimensions or (b) yielded scores that were inconsistent with other items on the same scale, and retained items with factor loadings of 0.300 or higher. This resulted in the omission of 3 items from the connection to wildlife scales, and no removal of items from other scales. Resulting scales are reported in appendices: Appendix A - 3 items for domination WVOs, 3 items for mutualism WVOs, Appendix B - 2 items for coexistence with wildlife, Appendix C - 3 items for wildlife affinity, 3 items for wildlife awareness. Cronbach's alpha scores for all final scales were below the commonly accepted threshold of 0.700, but this is not uncommon in exploratory research with a low scale-to-item ratio (Taber, 2018). We used the means of these subscales, rather than individual items, in all further analyses. SAPs were examined using mean ranks and the percentage of students rating an

attribute as most important.

To address Objective 1, we examined mean scores and frequencies for all wildlife perception variables of interest. We investigated gender differences in these variables using t-tests, and age differences (re-coded to 4 categories) using analyses of variance with Tukey's post hoc tests for group comparisons. To address Objective 2, we examined pre-to-post project score changes for individual students using paired t-tests. We also examined differences in change scores (calculated by subtracting individual post-test means from pre-test means), as well as self-reported change, based on level of project participation, time elapsed between surveys, gender, and age using t-tests and ANOVA. We reported Cohen's *d* (for t-tests) and eta-squared (for ANOVA) measures of effect size. We analyzed the results of the open-ended questions using open-coding, developing categories under which to group responses. An individual response could qualify for multiple categories.

RESULTS

Overall, 1448 students across 20 schools in India completed a pre-project survey. Of that group, 51.0% were boys and the age breakdown was as follows: 17.6% age 12 and under, 44.6% age 13, 26.8% age 14, 10.9% age 15 or older (mean age = 13.31, SD = 1.006). The pre-project surveys are the responses we used when addressing research objective 1 (overall youth perceptions of wildlife). Only 656 students completed both a pre- and post-project survey, and at least 14 students in every class did both. Of that group, 49.0% were boys and the age breakdown was as follows: 16.6% age 12 and under, 53.7% age 13, 24.5% age 14, 5.2% age 15 or older (mean age = 13.18, SD = 0.822). The post-project surveys are the responses we used when addressing research objective 2 (effects of citizen science participation on youth perceptions of wildlife).

Objective 1: Youth perceptions of wildlife

Wildlife Value Orientations

Most Indian youth reported high levels of mutualistic WVO scores (M = 4.22, SD = 0.60), with 94.5% of the participants reported positive mutualism scores (indicating strong mutualistic beliefs about wildlife). On the other hand, dominionistic WVO scores (M = 2.54, SD = 0.083) were significantly lower [$t(1447) = -59.0$, $p < 0.001$, Cohens' $d = -1.6$)], and only 21.8% of students reported positive domination scores. The mutualistic WVO scores for girls were 0.05 higher than the scores for boys, though this difference was not statistically significant ($t(1442) = 1.61$, $p = 0.107$). The dominionistic WVO scores for girls were 0.13 higher than the scores for boys, and this difference was statistically significant ($t(1442) = 2.71$, $p = 0.007$, Cohen's $d = 0.14$). Age differences in mutualistic WVO scores were also present ($F(3,1411) = 12.58$, $p < 0.001$, $N2 = 0.026$) and tended to decrease in older age groups, ranging from a high of 4.34 (SD = 0.59) in the 12 and under group and a low of 4.06 (SD = 0.59) in the 15 and older group (Figure 4). Dominionistic WVO scores were consistent across all age groups ($F(3,1411) = 0.24$, $p = 0.872$).

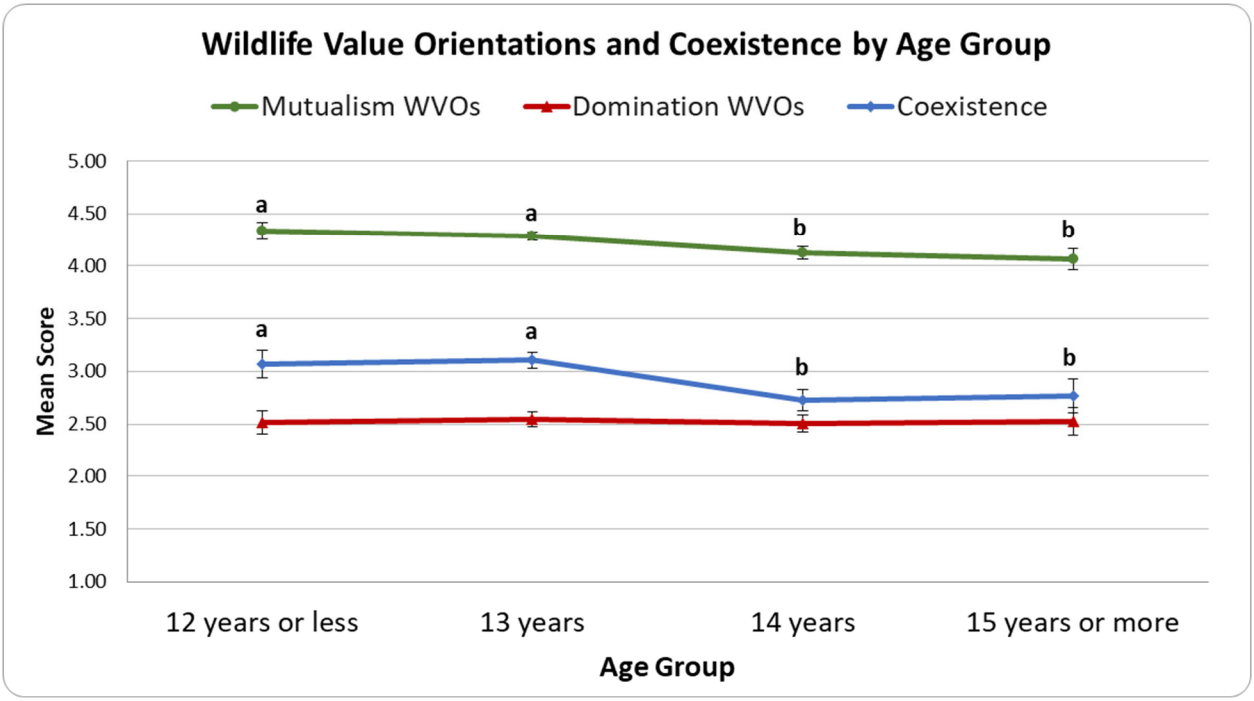

Figure 4. Comparison of mutualistic and dominionistic WVO scores and perceived coexistence scores for youth in India, by age group. Superscripts note statistically significant differences between age groups based on Tukey's post hoc comparisons. Error bars represent 95% confidence intervals.

Most Indian youth reported moderate levels of perceived capacity for coexistence with wildlife (*M* = 2.96, *SD* = 1.04), with 35.8% of the students reporting coexistence scores above the scale midpoint. The coexistence scores for girls were 0.06 higher than the scores for boys, though this difference was not statistically significant ($t(1442) = 1.06$, $p = 0.289$). Age differences in coexistence scores were present ($F(3,1411) = 13.71$, $p < 0.001$, $N2 = 0.028$) and tended to decrease in older age groups, ranging from a high of 3.10 (SD = 1.03) in the age 13 group and a low of 2.72 (SD = 1.02) in the age 14 group (Figure 4).

Species Attribute Preferences

Participants ranked species attributes from 1 to 5 in order of most importance, so lower scores indicate that an attribute was of greater perceived importance to conserve. Ecological value was ranked first by 42.6% of participants, with a mean rank of 2.14 (SD= 1.338). Rapid decline was ranked first by 34.6% of participants, with a mean rank of 2.30 (SD= 1.232). Endemism was ranked first by 9.9% of participants, and had a mean rank of 3.55 (SD= 1.230). Utilitarian value was ranked first by 9.3% of participants, with a mean rank of 3.63 (SD= 1.354). Aesthetic value was ranked first by 5.7% of participants, with a mean rank of 3.32 (SD= 1.174).

We observed significant differences between girls and boys at the $\propto$=.05 level. Compared to boys, girls were less likely to prioritize species that people like to eat ($t(1440) = 3.35$, $p < 0.001$, Cohen's $d = 0.08$) and more likely to prioritize species that have ecological value ($t(1440) = -4.90$, $p < 0.001$, Cohen's $d = -0.26$). Four attribute preferences were influenced by age. Compared to younger students, older students were more likely to prioritize the rapid decline ($F(3,1410) = 3.06$, $p = 0.027$, $N2 = 0.006$)

and ecological value attributes ($F(3,1406) = 6.91$, $p = 0.009$, $N2 = 0.008$). Compared to older students, younger students were more likely to prioritize the endemism ($F(3,1409) = 6.12$, $p < 0.001$, $N2 = 0.013$) and utilitarian attributes ($F(3,1408) = 5.69$, $p < 0.001$, $N2 = 0.012$). There were no major age differences in rankings for the aesthetic value attribute ($F(3,1410) = 0.93$, $p = 0.425$).

Connection to Wildlife

Most Indian youth reported high levels of wildlife affinity ($M = 4.43$, $SD = 0.53$), with 98.1% of the students reporting positive affinity scores. Similarly, most youth reported relatively high levels of wildlife awareness ($M = 3.69$, $SD = 0.78$), with 76.0% of students reporting positive awareness scores.

Wildlife affinity scores for girls were 0.03 higher than the scores for boys, though this difference was not statistically significant ($t(1442) = 1.12$, $p = 0.262$). The wildlife awareness scores for girls were 0.15 higher than the scores for boys, and this difference was statistically significant ($t(1442) = 3.76$, $p < 0.001$, Cohen's $d = 0.06$). Age differences in wildlife affinity scores were also present ($F(3,1411) = 15.01$, $p < 0.001$, $N2 = 0.031$) and tended to decrease in older age groups, ranging from a high of 4.55 (SD = 0.46) in the 12 and under age group and a low of 4.25 (SD = 0.55) in the 15 and older group (Figure 5). Similar age differences were seen for wildlife awareness scores ($F(3,1411) = 6.40$, $p < 0.001$, $N2 = 0.013$) and tended to decrease in older age groups, ranging from a high of 3.82 (SD = 0.79) in the 12 and under age group and a low of 3.57 (SD = 0.79) in the 15 and older group (Figure 5).

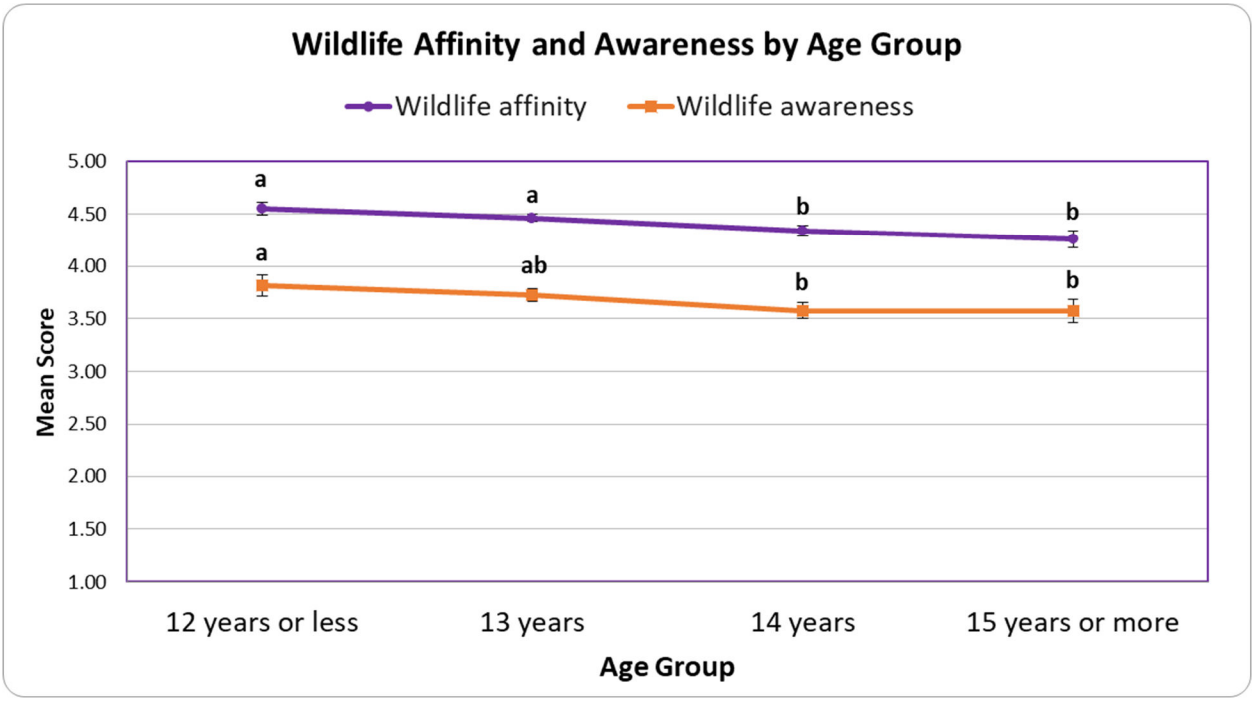

Figure 5. Comparison of wildlife affinity and wildlife awareness scores for youth in India, by age group. Superscripts note statistically significant differences between age groups based on Tukey's post hoc comparisons. Error bars represent 95% confidence intervals.

Objective 2: Impacts of Citizen Science Participation

To gauge different levels of participation, we asked students who took the post-survey (n = 656) to indicate how they were involved in the project. Options included helping set up cameras (36.0% of students did this), viewing wildlife photos from their school (38.6%), viewing wildlife photos from other schools (17.5%), and talking to other classes about wildlife (16.0%). Based on these responses, we grouped students into two larger categories based on their citizen project participation levels: (1) low/indirect participation that included no cameras or photos of wildlife at their school and only interactions with photos and students at other participating schools (30.5%), or (2) high/direct participation that included setting up and viewing camera trap photos of wildlife taken at their own school (69.5%). The length of time that elapsed between taking the pre and post-test (i.e., the duration of project participation) ranged between 2 and 19 months.To determine if time involved in the project was important, we used two categories to examine time elapsed between surveys: 12 months or less (35.4% of students) and more than 12 months (64.6%).

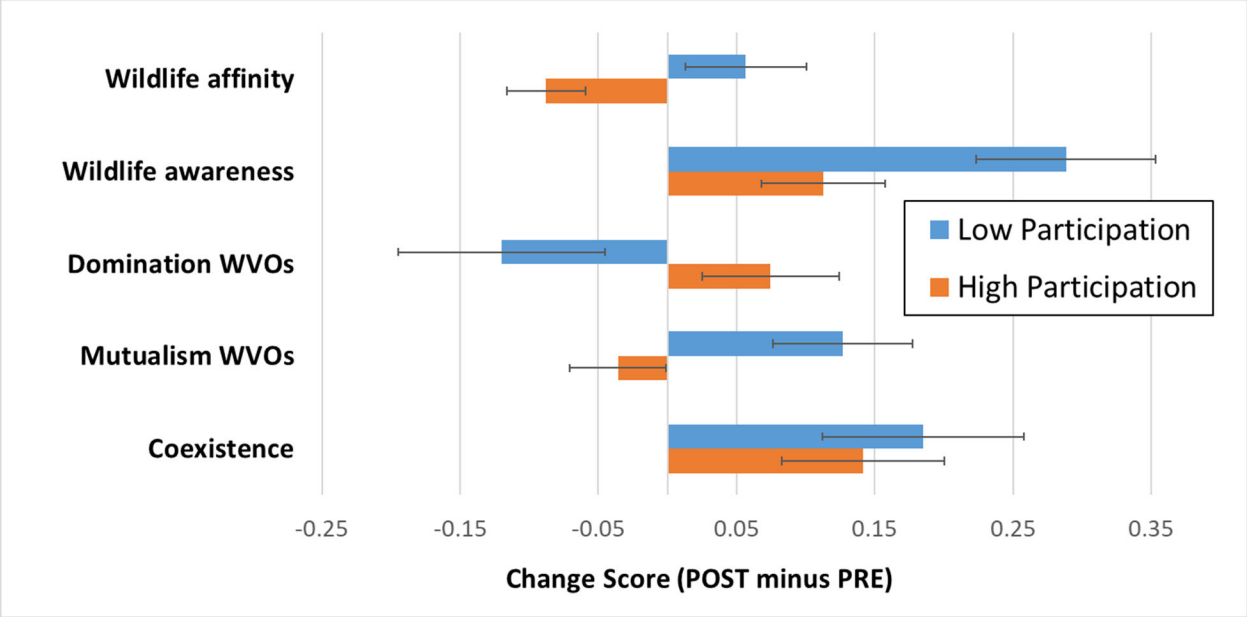

Figure 6. Comparison of changes in mutualistic and dominionistic WVO scores, perceived coexistence scores, and wildlife affinity and wildlife awareness scores following citizen science project participation for youth in India. Different colors represent low participation vs. high participation in the citizen science project. Error bars represent standard error.

Wildlife Value Orientations

Paired t-tests revealed minimal increases (+<0.02) in both mean mutualistic WVO scores [$t(655) = 0.48$, $p = 0.633$, 39.8% reported an increase)] and mean dominionistic WVO scores [$t(655) = 0.37$, $p = 0.713$, 42.2% reported an increase)] following project participation (Figure 6). Comparisons of change scores showed that students in the low participation group reported larger gains in mutualistic WVO scores compared to students in the high participation group [$t(654) = 2.61$, $p = 0.009$, Cohen's $d = 0.22$)] ; however, students in the high participation group reported greater gains in dominionistic WVO scores than students in the low participation group [$t(654) = -2.17$, $p = 0.030$, Cohen's $d = -0.18$)]. Changes in both types of WVO scores did not differ significantly based on the length of time that elapsed between pre and post-project surveys. Girls and boys both reported roughly equal but minimal gains in mutualistic WVO scores after the project, but boys reported significantly larger gains (+0.31) in dominionistic WVO scores relative to girls, whose scores actually decreased slightly [$t(653) = -3.80$, $p < 0.030$, Cohen's $d = -0.30$)]. We did not observe significant age differences in either mutualistic or dominionistic WVO change scores following project participation, though the largest score gains were typically seen in the older age groups.

Potential for Coexistence

Paired t-tests revealed significant increases (+0.16) in mean perceived coexistence scores [$t(655) = 3.33$, $p < 0.001$, Cohen's $d = 0.13$, 44.8% reported an increase)] following project participation (Figure 6). Comparisons of change scores revealed few differences in perceived coexistence scores based on level of project participation [$t(654) = 0.43$, $p = 0.667$]. The change in perceived coexistence scores was greater (+0.20) for students with more than 12 months between pre- and post-project surveys compared those who took surveys within the same year [$t(654) = -1.98$, $p = 0.024$, Cohen's $d = 0.18$)]. Girls and boys both reported approximately equal gains in perceived coexistence scores after the project [$t(653) = -1.00$, $p = 0.317$]. We did not observe significant age differences in either perceived coexistence change scores following project participation, though the largest score gains were typically seen in the older age groups [$F(3,655) = 1.63$, $p = 0.180$].

Species Attribute Preferences

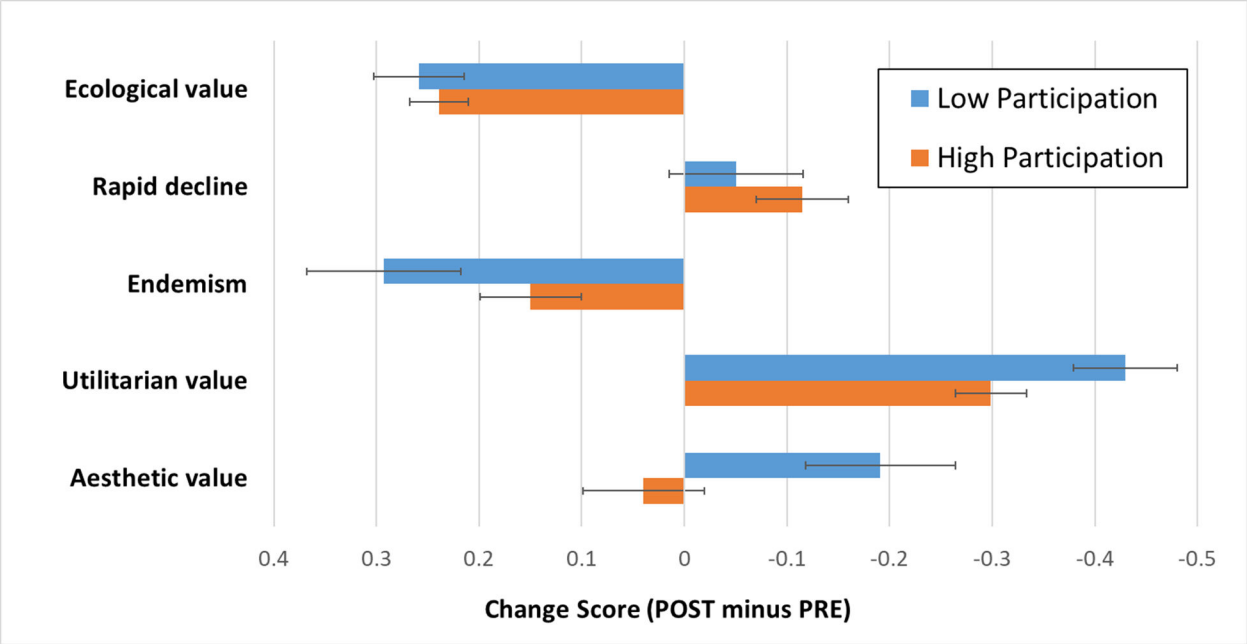

Figure 7. Comparison of changes in species attribute scores following citizen science project participation for youth in India. Different colors represent low participation vs. high participation in the citizen science project. Error bars represent standard error.

Paired t-tests revealed significant changes in the mean rankings for three species attributes (with higher rankings post-project indicating lower perceived importance): ecological value was ranked as less important [$t(650) = 3.62$, $p < 0.001$, Cohen's d = 0.14, 29.6% ranked it more important after project)], endemism was ranked as less important [$t(637) = 3.14$, $p < 0.001$, Cohen's d = 0.12, 30.4% ranked it more important after project)], and utilitarian value was ranked as more important [$t(649) = -4.48$, $p < 0.001$, Cohen's d = -0.18, 41.2% ranked it more important after project)]. Mean rankings did not change significantly for two species attributes: aesthetic value [$t(651) = -0.46$, $p = 0.648$, 39.9% ranked it more important after project)], and rapid decline [$t(651) = -1.37$, $p = 0.172$, 39.4% ranked it more important after project)]

Comparisons of mean ranking changes before and after the project showed no significant differences based on students' level of participation (Figure 7). However, we observed significant differences in mean ranking changes based on project duration. Compared to students who participated in the project for 12 months or more, students participating for less than a year reported larger mean ranking decreases for endemism [$t(636) = 4.20$, $p < 0.001$, Cohen's d = 0.35] and utilitarian value [$t(648) = 2.41$, $p = 0.008$, Cohen's d = 0.20], and larger mean ranking increases for rapid decline [$t(650) = -4.49$, $p < 0.001$, Cohen's d = -0.37] and ecological value [$t(649) = -2.13$, $p = 0.017$, Cohen's d = -0.17]. There was no significant difference in mean ranking changes for aesthetic value based on project duration. Compared to girls, boys reported larger mean ranking increases in ecological value [$t(648) = 2.73$, $p = 0.001$, Cohen's d = 0.21]. Both girls and boys reported significant mean ranking decreases (i.e., higher importance) in the ranking of utilitarian value, but this mean ranking shift was larger for girls [$t(647) = -2.07$, $p = 0.020$, Cohen's d = -0.16]. Gender differences in mean ranking shifts were not observed for the other attributes. Compared to girls, boys reported larger mean ranking increases in ecological value

[t(648) = 2.73, p = 0.001, Cohen's d = 0.21]. Both girls and boys reported increases in the ranking of utilitarian value, but this mean ranking shift was larger for girls [t(647) = -2.07, p = 0.020, Cohen's d = -0.16]. Gender differences in mean ranking shifts were not observed for the other attributes. Age differences in mean ranking changes were minimal, with the exception of one attribute: in general, compared to younger students, older youth reported larger mean ranking increases in endemism [F(3,637) = 5.86, p < 0.001, N2 = 0.027.]

Connection to Wildlife

Paired t-tests revealed a slight but insignificant decrease (-<0.04) in mean wildlife affinity scores [t(655) = -1.82, p = 0.070, 32.9% reported an increase)], and a significant positive increase (+0.17) in wildlife awareness scores [t(655) = 4.48, p < 0.001, Cohen's d = 0.18, 48.5% reported an increase)], following project participation (Figure 6). Comparisons of change scores showed that students in the low participation group reported larger gains in both wildlife affinity scores [t(654) = 2.77, p = 0.003, Cohen's d = 0.24] and wildlife awareness scores [t(654) = 2.19, p = 0.014, Cohen's d = 0.19] compared to students in the high participation group. Changes in wildlife affinity scores did not differ significantly based on the length of time that elapsed between pre and post-project surveys, though students who experienced more than 12 months between surveys reported larger increases (+0.27) in wildlife awareness scores than students whose participation lasted less than a year [t(654) = -3.54, p < 0.001, Cohen's d = -0.29]. Girls and boys both reported equally minimal changes in wildlife affinity scores [t(653) = -1.66, p = 0.098], and similar gains in wildlife awareness scores [t(653) = -1.50, p = 0.133], after project participation. We did not observe significant age differences in either wildlife affinity or wildlife awareness score changes following project participation, though the largest score gains were typically seen in the older age groups.

Self-Reported Participation Outcomes

After participating in the project, Indian youth self-reported major gains in a variety of outcomes (Figure 8). For example, 92.7% of students said their interest in wildlife increased, 92.0% said their connection to wildlife increased, 95.2% said their knowledge of local wildlife increased, and 97.6% said their desire to protect wildlife increased. We did not observe significant differences in self-reported outcomes based on level or duration of project participation. Differences in self-reported outcomes by gender and age were also minimal, though girls were slightly more likely to report an increased desire to protect wildlife [t(652) = 1.85, p = 0.033, Cohen's d = 0.14].

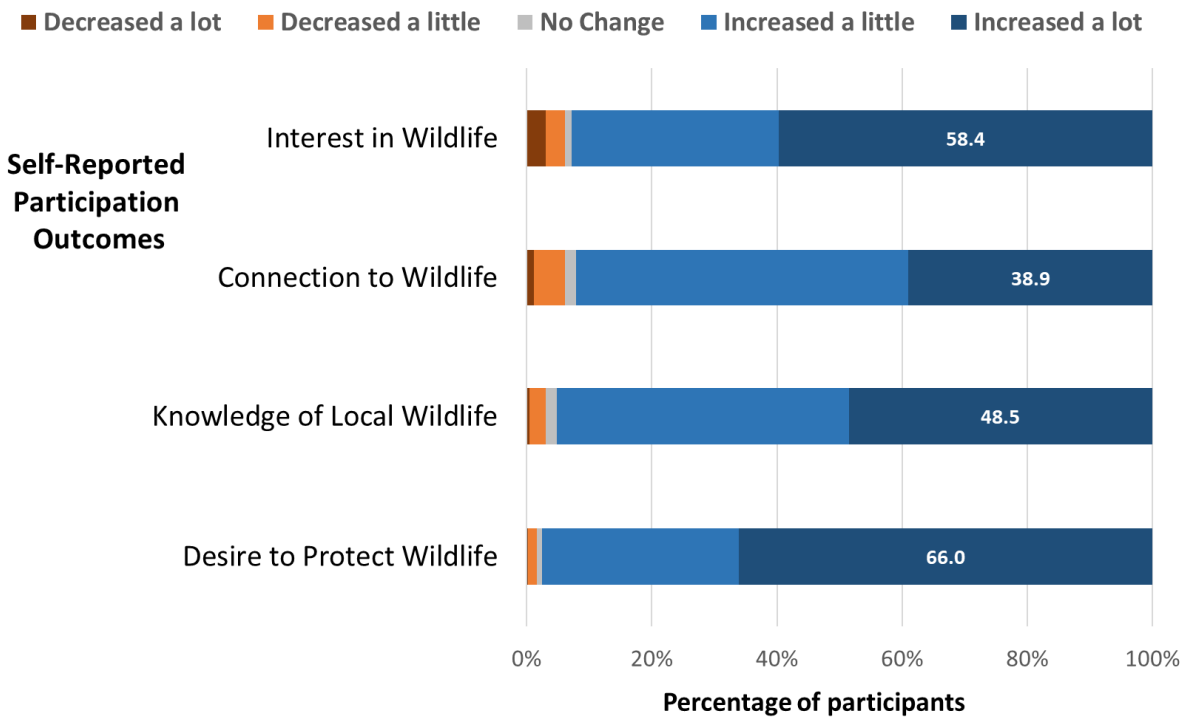

Figure 8. India youth's self-rated outcomes associated with participation in a citizen science project focused on camera-trapping wildlife in their communities.

Perceptions of the Program

We asked participants two open-ended questions on the post-test to get a sense what they enjoyed the most in the citizen science project and what they learned. We received 602 responses to the first question and 588 responses to the second question.

Favorite experiences

Researchers developed six codes to classify responses to the question "What was your favorite part about the eMammal project?": Cameras/equipment (50%), learning about animals/conservation (43.5%), observing animals/images (38.7%), interactions with others (4.4%), connecting with animals (3.8%), and other activities (9.8%). Descriptions and example items for each code can be found in Table 1.

Table 1: "What was your favorite part about the eMammal project?"

Code	Meaning	Example
Cameras/Equipment	Student describes the deployment of cameras	" to use laptop, projector, trap cameras and collect information of mammals"
Observing animals/Images	Student describes observing animals or seeing the images from the camera traps.	"to see diversity of mammals" , "To observe camera trap photos"

Other activities	There seem to have been other activities included in the programs at various schools: a nature trail, quiz competition, drawing competition, and essay competition	"Drawing competition", "Essay competition"
Interacting with others	Student describes talking with students from other schools, sharing photos with "batchmates"	"TO MEET STUDENTS FROM OTHER SCHOOLS AND DISCUSS ABOUT MAMMALS WITH THEM."
Learning about animals/conservation	Related to having learned/"collected information" on animals, learning about safety/awareness of animals, learning about conservation/saving/protecting animals	"learn about mammals and science", "Collecting Information of different animals", "protection and conservation of animals", "learn about venomous and non-venomous snake species in our region", "we should not harm animals"
Connecting with animals	Describing an awareness of animal's importance to man/nature/the world, expressing a positive sentiment towards wildlife	"Importance of species in our life ", "to respect animals and love them", " Love affection towards species and their importance for our survival"

Educational takeaways

We developed six codes to classify responses to the question, “What is one thing you learned from the eMammal project?”: Conservation actions (68%), learning about animals (53.7%), connecting with animals (25.5%), cameras/equipment (12.5%), interacting with others (1%), and career (.51%). Descriptions and example items for each code can be found in Table 2.

Table 2: "What is one thing you learned from the eMammal project?"

Codes	**Meaning**	**Example**
Conservation Actions	Student describes learning about conservation, a conservation action, "protecting/saving" animals, stopping hunting/poaching, communicating about conservation, etc	"Learn to save wild animals", "stop hunting and poaching", "to ... create artificial ponds for wildanimals in jungle for summer season", "we should not harm animals"
Learning about animals	Relating to learning about animals, "collecting information" on animals, "their information", learning about safety around wildlife/awareness	"learn about diversity of mammals of my region ", "HOW TO IDENTIFY LOCAL BIRDS", "aware about snakes and their myths", "wild animals are not harmful to us"
Cameras/Equipment	Student describes the deployment of cameras	"learn how to deployed trap camera on field"

Connecting with Animals	The response contains a positive sentiment towards animals, the importance that animals have to nature/humans/the world	"We should lovingly cuddle and protect animals", "Affection towards animals increased and the thought of saving them is ignited ", "animals are important for humans"
Interacting with others	Student mentions interacting with others, spreading information to others, communicating	"... Also making new friends", "to give information to villagers"
Career	Any mentions of careers/vocational literacy	"...and choose a career in science"

DISCUSSION

This study was among the first to explore youth perceptions of wildlife outside of the Global North, and to consider the effects of an educational intervention (in this case, engagement in citizen science) that might influence those perceptions. Our findings yield unique insights for environmental education research and practice.

Youth perceptions of wildlife

Baseline assessment of wildlife perceptions revealed that Indian youth were more likely to express mutualistic than dominionistic wildlife values. As a whole, Indian youth also reported high levels of wildlife affinity and relatively high levels of wildlife awareness. These patterns align with existing literature reporting strong emotional connections between youth and wildlife specifically (Kellert, 1985), as well as broader affinity for nature (Bowers et al., 2021). Although other studies have found more negative views of wildlife among youth in Global South countries such as Kenya (Thomas et al., 2015), this might not be the case in India, perhaps because of longstanding cultural values that celebrate a deep connection with wildlife and nature (Jolly et al., 2022; Stevens et al., 2025). We observed neutral scores for coexistence, our construct for beliefs about the possibility of human-wildlife coexistence. The concept of coexistence is important but understudied, partly because it is difficult to operationalize (Pooley et al., 2021; Stevens et al., 2025). Our results suggest that: (a) many youth in India may not view harmonious coexistence with wildlife as a viable option, and (b) more research is needed to understand how the concept of human-wildlife coexistence applies to youth.

In our baseline assessment of SAPs, ecological importance and rapid decline were the attributes most likely to be ranked as high-priority conservation targets by Indian youth. These findings could be interpreted to indicate that wildlife conservation preferences among youth in India align with those valued by conservation biologists (Frew et al., 2016). Participants' high ranking of ecological importance aligns with the patterns observed in Bahamian children by Shapiro et al. (2016), although Bahamian youth were more likely to rank endemism highly as well (perhaps due to their location on an island). We observed significant differences in conservation preferences between girls and boys, contrary to the findings of Frew et al. (2016) and Liles et al. (2021), but aligned with the findings of Shapiro et al. (2016). Compared to boys, girls were less likely to prioritize utilitarian attributes and more likely to prioritize species that have ecological value. We also observed four attribute preferences that were influenced by

age, which generally aligned with the findings of Shapiro et al. (2016). Older students were more likely to prioritize the rapid decline and ecological value attributes, and younger students were more likely to prioritize the endemism and utilitarian attributes. These findings could be explained by the positive correlation between age and wildlife awareness described by Kellert (1985).

In our sample of Indian youth, we observed several demographic correlates of wildlife value orientations and connections to wildlife that both mirror and contradict results documented in previous research of youth in the global North. For example, we found that wildlife affinity and awareness generally declined with age, with students in the 12 and under age group reporting significantly higher levels of affinity and awareness than older students. Other authors have shown precipitous declines in children's desire to spend time outdoors in nature beginning around age 11 or 12 (Larson et al., 2010b; Larson et al., 2011; Leeming et al., 1995). Multiple factors could explain this shift, sometimes dubbed the "adolescent gap," including shifting interests and priorities that favor social interaction and development (Vadala et al., 2007), busier schedules as youth enter adolescence (Skår and Krogh, 2009), and a rise in screen time versus outdoor time (Larson et al., 2019). Some authors have described these age-related shifts as the "adolescent dip" or gap in nature connection (Keith et al., 2021; Richardson et al., 2019), whereas others reference a broader "extinction of experience" across generations (Soga and Gaston, 2016). Whatever the name, it seems that age-related declines in youth's wildlife values and connections are consistent across counties and have global conservation implications. Gender-based differences in wildlife values and connections were more nuanced. Studies in Global North countries have typically found that women tend to express more mutualistic wildlife values than men (Czech et al., 2001; Notaro et al., 2024; Vaske et al., 2011), though these studies primarily focus on adults. But these patterns may be different in Global South countries, with women actually expressing more dominionistic values (Jacobs et al., 2022; Jafarpour and Manohar, 2014). In our sample, girls were slightly more dominionistic than boys, but they also expressed higher levels of wildlife affinity and awareness. Other studies of youth and young adults have shown that girls may be more motivated than boys to engage with nature and to care about animal protection (Herzog, 2007); our results suggest that pattern may be consistent across multiple countries including India. The age and gender-related variation observed in our study underscores the importance of designing tailored, audience-specific interventions to promote positive interactions between youth and wildlife, regardless of cultural context.

Impacts of citizen science participation

Our second objective, to understand how the citizen science intervention affected Indian youth and their attitudes towards wildlife, revealed somewhat predictable benefits similar to those seen in other studies (Ballard et al., 2017). According to self-reported outcomes, the citizen science project generated a variety of benefits, strengthening students' interest in wildlife, connection to wildlife, knowledge of wildlife, and desire to protect wildlife. The pro-environmental outcomes have been documented in many other citizen science project evaluations focused on adults (McKinley et al., 2017; Peter et al., 2019). Additionally, some researchers have found success facilitating human-wildlife coexistence in the Global South by implementing camera trap initiatives with incentives depending on the rarity of wildlife captured (Dickman et al., 2025), an interesting parallel to the concepts explored in our study. However, pre-post comparisons reveal a more nuanced experience for Indian youth.

The wildlife awareness of Indian youth increased a lot following participation, but not wildlife affinity. This aligns with trends observed in other environmental education programs, such as those described in Ardoin et al. (2020), Kuhar et al. (2007), and Mascovich et al. (2023), indicating that gains in knowledge and awareness may be easier to achieve than affective change in conventional educational settings. Similar patterns have been observed in previous camera trapping projects, where volunteer knowledge improved following participation but attitudes remained unchanged (Forrester et al., 2017). In our study, shifts in wildlife value orientations were minimal, reflecting previous research showing that values are hard to change via environmental education (Krasny, 2020). To alter values and boost affinity, both important antecedents for behavior change, program experiences may need to be reconceptualized with these outcomes in mind (Thomas et al., 2019). For instance, O'Hare et al. (2020) found that students respond better to environmental education programs that integrate positive emotional support behaviors. Hinds and O'Malley (2019) described how participation in a longitudinal outdoor experiential education program fostered perceived competence, hope, and positive nature connectedness. Education program designers, including those using citizen science elements, could take these approaches into account when attempting to bolster affective connections to wildlife. Alternatively, minimal gains in self-reported affinity might be attributed to a "ceiling effect" where participants scored so high on the pre-test there was little from growth following program participation. This is a common challenge in environmental education (Powell et al., 2019), and might require new and innovative measurement tools to more effectively capture change.

Our results also suggest that youth's level of participation in the citizen science program didn't matter that much; even lower and more indirect participation in the project (i.e., simply viewing other school's photos instead of collecting their own) produced outcome shifts. This aligns with other studies suggesting that any type of participation in conservation education - regardless of type or duration - is likely to produce some benefits for youth participants (Bernd and Nitz, 2023; Mascovich et al., 2023; Skupien et al., 2016). For instance, any level of participation in the citizen science project increased youth perceptions of the potential for coexistence with wildlife, a key aspect of tolerance that can foster positive human-wildlife interactions (Skupien et al., 2016). Additionally, the program we evaluated seemed to benefit all students relatively equally, especially with respect to age. This could have important implications for educators hoping to address the aforementioned "adolescent gap" in connections to wildlife and nature; if older students have an opportunity to experience these types of programs, they may derive benefits similar to their younger counterparts.

Limitations and Future Research

Several limitations of our study could be addressed in future research. First, project implementation was limited in scope and scale. We only sampled in one state in India (Maharashtra) and only focused on youth aged 12-15, though we did focus on 20 different schools; future evaluations with a wider geographic scope of inquiry could add greater context to our findings, both within and across India. Second, although our scales were based on previously validated instruments, they were not adequately pilot tested in this new and unique population (which explains some of the weak psychometric properties we observed). There is a need to validate these scales, derived in Western contexts, in diverse samples (Rosa et al., 2022; Rosa et al., 2023). Third, future research might also focus on measuring more behavioral outcomes and long-term changes, an increasingly important goal of

many environmental education evaluation efforts (Ardoin et al., 2020). Our analysis did not account for behavioral shifts after the end of the project.

Fourth, as American researchers divorced from the socioeconomic context of the regions sampled, we relied heavily upon Indian collaborators for data collection and interpretation. It is possible that we overlooked or did not adequately account for culturally-relevant factors that influenced our findings (Anderson et al., 2022). We also lack the full context to determine if the sampling techniques deployed in classrooms or culturally-mediated reference bias, such as that observed in a similar context by Salazar et al. (2021) could have influenced the responses we received; Salazar et al. (2021) noted that Indian youth in their study displayed awareness of peers' opinions and hesitated to diverge from the group, which could alter the verity of individual participant's feedback. Fifth, we want to caution against any interpretation that certain values ascribed to our outcome variables such as wildlife value orientations, species attribute preferences, or wildlife affinity is inherently good or bad. In wildlife conservation, due in large part to its colonial roots, Western scientists tend to assign higher values to their own ways of thinking (Jagadeesh et al., 2024). Does a child whose understanding of conservation comes from watching documentaries, who values the attributes most aligned with Western science, have a more "correct" relationship with wildlife than a child who perceives conservation as linked to their familial livelihood through direct consumption or income generation? Similarly, in terms of wildlife values, the Western assumption that dominionistic beliefs are more "primitive" than mutualistic beliefs, which emerge as societies develop and their relationship to the land change (Manfredo et al., 2020), may not hold across the Global South. We challenge the implication that traditional, use-oriented beliefs are inherently less favorable towards conservation and human-wildlife coexistence (He and Jiao, 2023), and we encourage researchers studying these topics to do the same. Despite these limitations, this study offers unique insights in a novel geographic and educational context. The relationships of international youth to wildlife and nature are complicated, nuanced, and difficult to capture in full, yet this is precisely why it is necessary to try, as youth perspectives remain pervasively underdocumented (Jagadeesh et al., 2024; Salazar et al., 2021).

CONCLUSION

Our study shows that youth in India express perceptions of wildlife that are relatively similar to youth in many Global North countries. They were highly mutualistic and expressed positive wildlife affinity, even before a citizen science intervention. We also observed consistent declines in variables such as wildlife affinity, wildlife awareness, and coexistence beliefs across each successive age category, suggesting that the proposed "adolescent gap" in nature connection could be a global phenomenon. But we also found that citizen science can help foster stronger connections between youth and wildlife regardless of age or other demographic attributes, potentially mitigating some of these declines. Regardless of how much they participated in the eMammal camera trapping project, youth reported increases in wildlife awareness and coexistence beliefs. Participants also indicated their interest in wildlife and desire to protect wildlife increased after participating in the program. Given these promising patterns, there is a need for more international research about youth perceptions of wildlife across different age ranges and using novel measurement tools, and how they might be impacted by

interventions such as citizen science. This proposed further inquiry could contribute to environmental literacy and support public participation in science at conservation at multiple scales.

References

Anderson, K. C., Stern, M. J., Powell, R. B., Dayer, A. A., & Archibald, T. G. (2022). A culturally responsive evaluation framework and its application in environmental education. Evaluation and Program Planning, 92, 102073.

Ardoin, N. M., Bowers, A. W., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. Biological conservation, 241, 108224.

Ballard, H. L., Dixon, C. G. H., & Harris, E. M. (2017). Youth-focused citizen science: Examining the role of environmental science learning and agency for conservation. Biological Conservation, 208, 65–75. https://doi.org/10.1016/j.biocon.2016.05.024

Berndt, J., & Nitz, S. (2023). Learning in Citizen Science: The Effects of Different Participation Opportunities on Students' Knowledge and Attitudes. Sustainability, 15(16), 12264. https://doi.org/10.3390/su151612264

Bird, E. B., Ballard, H. L., & Harte, M. (2023). Data to decision-making: how elementary students use their Community and Citizen Science project to reimagine their school campus. Instructional Science. https://doi.org/10.1007/s11251-022-09612-6

Bowers, E. P., Larson, L. R., & Parry, B. J. (2021). Nature as an ecological asset for positive youth development: Empirical evidence from rural communities. Frontiers in psychology, 12, 688574.

Chang'a, A., de Souza, N., Muya, J., Keyyu, J., Mwakatobe, A., Malugu, L., Ndossi, H. P., Konuche, J., Omondi, R., Mpinge, A., Hahn, N., Palminteri, S. and Olson, D. 2016. Scaling-up the use of chili fences for reducing human-elephant conflict across landscapes in Tanzania. Tropical Conservation Science Vol. 9 (2): 921-930. Available online: www.tropicalconservationscience.org

Cheng, J. C.-H., & Monroe, M. C. (2010). Connection to Nature: Children's Affective Attitude Toward Nature. Environment and Behavior, 44(1), 31–49. https://doi.org/10.1177/0013916510385082

Cho, C. K., Kim, B. Y., & Stoltman, J. P. (2020). Animal identity and space as represented in South Korean geography textbooks. International Research in Geographical and Environmental Education, 31(1), 53–68. https://doi.org/10.1080/10382046.2020.1852787

Clark, K. E., Cupp, K., Phelps, C. L., Peterson, M. N., Stevenson, K. T., & Serenari, C. (2017). Household dynamics of wildlife value orientations. Human Dimensions of Wildlife, 22(5), 483-491.

Cronje, R., Rohlinger, S., Crall, A., & Newman, G. (2011). Does participation in citizen science improve scientific literacy? A study to compare assessment methods. Applied Environmental Education & Communication, 10(3), 135-145.

Czech, B., Devers, P. K., & Krausman, P. R. (2001). The relationship of gender to species conservation attitudes. Wildlife Society Bulletin, 187-194.

Dickman, A., Cotterill, A., Asecheka, S., Mlaponi, Z., Mbugi, H., Grau, A., ... & Cascio, B. (2025) Community Camera Trapping: A Novel Method for Encouraging Human–Big Cat Coexistence on Human-Dominated Land. Wildlife Letters.

Driscoll, D. A., Bland, L. M., Bryan, B. A., Newsome, T. M., Nicholson, E., Ritchie, E. G., & Doherty, T. S. (2018). A biodiversity-crisis hierarchy to evaluate and refine conservation indicators. Nature Ecology & Evolution, 2(5), 775-781.

Duvall, J., & Zint, M. (2007). A Review of Research on the Effectiveness of Environmental Education in Promoting Intergenerational Learning. The Journal of Environmental Education, 38(4), 14–24. https://doi.org/10.3200/joee.38.4.14-24

Forrester, T. D., Baker, M., Costello, R., Kays, R., Parsons, A. W., & McShea, W. J. (2017). Creating advocates for mammal conservation through citizen science. Biological Conservation, 208, 98-105.

Mayer, F. S., & Frantz, C. M. (2004). The connectedness to nature scale: A measure of individuals' feeling in community with nature. Journal of Environmental Psychology, 24(4), 503–515. https://doi.org/10.1016/j.jenvp.2004.10.001

Frew, K., Peterson, M. N., & Stevenson, K. (2016). Are we working to save the species our children want to protect? Evaluating species attribute preferences among children. Oryx, 51(3), 455–463. https://doi.org/10.1017/s0030605315001477

Gamborg, C., & Jensen, F. S. (2016). Wildlife value orientations: A quantitative study of the general public in Denmark. Human Dimensions of Wildlife, 21(1), 34-46.

He, S., & Jiao, W. (2023). Conservation-compatible livelihoods: An approach to rural development in protected areas of developing countries. Environmental Development, 45, 100797.

Herzog, H. A. (2007). Gender differences in human–animal interactions: A review. Anthrozoös, 20(1), 7-21.

Hinds, J., & O'Malley, S. (2019). Assessing nature connection and well-being during an experiential environmental program. Children, youth and environments, 29(2), 92-107.

Inglis, M. I. (2020). Wildlife ethics and practice: Why we need to change the way we talk about 'invasive species'. Journal of Agricultural and Environmental Ethics, 33(2), 299-313.

Jacobs, M. H., Dubois, S., Hosaka, T., Ladanović, V., Muslim, H. F. M., Miller, K. K., ... & Abidin, Z. A. Z. (2022). Exploring cultural differences in wildlife value orientations using student samples in seven nations. Biodiversity and Conservation, 31(3), 757-777.

Jafarpour, M., & Manohar, M. (2014). Wildlife value orientations based on age, gender and education in Malaysia. Life Science Journal, 11(6), 194-201.

Jagadeesh, S. N. (2024). Changing natures: a perspective on youth and conservation futures. Frontiers in Human Dynamics, 6, 1290856.

Jolly, H., Satterfield, T., Kandlikar, M., & Tr, S. (2022). Indigenous insights on human–wildlife coexistence in southern India. Conservation Biology, 36(6), e13981.

Kahn, P. H. (1997). Developmental Psychology and the Biophilia Hypothesis: Children's Affiliation with Nature. Developmental Review, 17(1), 1–61. https://doi.org/10.1006/drev.1996.0430

KC, B., Min, J., & Serenari, C. (2022). Segmenting wildlife value orientations to mitigate human–wildlife conflict for ecotourism development in protected areas. Tourism Planning & Development, 19(4), 339-356.

Keith, R. J., Given, L. M., Martin, J. M., & Hochuli, D. F. (2021). Urban children's connections to nature and environmental behaviors differ with age and gender. PloS one, 16(7), e0255421.

Kellert, S.R. (1984). Attitudes toward animals: Age-related development among children. In M.W. Fox & L.D. Mickley (Eds.), Advances in animal welfare science 1984/85 (pp. 43-60). Washington, DC: The Humane Society of the United States.

Krasny, M. E. (2020). Advancing environmental education practice (p. 312). Cornell University Press.

Kuhar, C. W., Bettinger, T. L., Lehnhardt, K., Townsend, S., & Cox, D. (2007). Into the Forest: The Evolution of a Conservation Education Program at Kalinzu Forest Reserve, Uganda. Applied Environmental Education & Communication, 6(2), 159–166. https://doi.org/10.1080/15330150701598213

Larson, L. R., Green, G. T., & Castleberry, S. B. (2009). Construction and Validation of an Instrument to Measure Environmental Orientations in a Diverse Group of Children. Environment and Behavior, 43(1), 72–89. https://doi.org/10.1177/0013916509345212

Larson, L. R., Castleberry, S. B., & Green, G. T. (2010)a. Effects of an environmental education program on the environmental orientations of children from different gender, age, and ethnic groups. Journal of Park and Recreation Administration, 28(3).

Larson, L. R., Green, G. T., & Castleberry, S. B. (2010)b. I'm too old to go outside! Examining age-related differences in children's environmental orientations. In Proceedings of the 2009 northeastern recreation research symposium (Vol. 57, No. 156, p. 3).

Larson, L. R., Green, G. T., & Cordell, H. K. (2011). Children's Time Outdoors: Results and Implications of the National Kids Survey. Journal of Park and Recreation Administration, 29(2), 1-20.

Larson, L. R., Conway, A. L., Hernandez, S. M., & Carroll, J. P. (2016). Human-wildlife conflict, conservation attitudes, and a potential role for citizen science in Sierra Leone, Africa. Conservation and Society, 14(3), 205-217.

Larson, L. R., Szczytko, R., Bowers, E. P., Stephens, L. E., Stevenson, K. T., & Floyd, M. F. (2019). Outdoor time, screen time, and connection to nature: troubling trends among rural youth?. Environment and Behavior, 51(8), 966-991.

Leeming, F. C., Dwyer, W. O., & Bracken, B. A. (1995). Children's environmental attitude and knowledge scale: Construction and validation. The journal of environmental education, 26(3), 22-31.

Liles, M. J., Peterson, M. N., Stevenson, K. T., & Peterson, M. J. (2021). Youth wildlife preferences and species-based conservation priorities in a low-income biodiversity hotspot region. Environmental Conservation, 48(2), 110–117. https://doi.org/10.1017/s0376892921000035

Lira, B., O'Brien, J. M., Peña, P. A., Galla, B. M., D'Mello, S., Yeager, D. S., ... & Duckworth, A. L. (2022). Large studies reveal how reference bias limits policy applications of self-report measures. Scientific Reports, 12(1), 19189.

Louv, R. (2008). Last child in the woods: Saving our children from nature-deficit disorder. Algonquin books

Malleshappa, V., Smithsonian, E., Schuttler, S., Support, W., Kays, R.. 2000. Last updated April 2023. Museums Connect India. http://n2t.net/ark:/63614/w12004304. Accessed via wildlifeinsights.org on 2025-02-20.

Manfredo, M. J., Teel, T. L., Don Carlos, A. W., Sullivan, L., Bright, A. D., Dietsch, A. M., ... & Fulton, D. (2020). The changing sociocultural context of wildlife conservation. Conservation Biology, 34(6), 1549-1559.

Manfredo, M. J., Berl, R. E., Teel, T. L., & Bruskotter, J. T. (2021). Bringing social values to wildlife conservation decisions. Frontiers in Ecology and the Environment, 19(6), 355-362.

Manfredo, M. J., Teel, T. L., Berl, R. E. W., Bruskotter, J. T., & Kitayama, S. (2020). Social value shift in favour of biodiversity conservation in the United States. Nature Sustainability, 4(4), 323–330. https://doi.org/10.1038/s41893-020-00655-6

Marchini, S., & Macdonald, D. W. (2019). Can school children influence adults' behavior toward jaguars? Evidence of intergenerational learning in education for conservation. Ambio. https://doi.org/10.1007/s13280-019-01230-w

Mascovich, K. A., Larson, L. R., & Andrews, K. M. (2023). Talking Turtles With Tourists: Evaluating the Relative Conservation Impacts of Different Types of Sea Turtle Education Programs at Jekyll Island, GA, USA. Journal of Interpretation Research, 28(1), 95-120.

McKinley, D. C., Miller-Rushing, A. J., Ballard, H. L., Bonney, R., Brown, H., Cook-Patton, S. C., Evans, D. M., French, R. A., Parrish, J. K., Phillips, T. B., Ryan, S. F., Shanley, L. A., Shirk, J. L., Stepenuck, K. F., Weltzin, J. F., Wiggins, A., Boyle, O. D., Briggs, R. D., Chapin, S. F., & Hewitt, D. A. (2017). Citizen science can improve conservation science, natural resource management, and environmental protection. Biological Conservation, 208, 15–28. https://doi.org/10.1016/j.biocon.2016.05.015

MEUSER, E., HARSHAW, H.W. and MOOERS, A.Ø. (2009), Public Preference for Endemism over Other Conservation-Related Species Attributes. Conservation Biology, 23: 1041-1046. https://doi-org.prox.lib.ncsu.edu/10.1111/j.1523-1739.2009.01257.x

Newman, G., Chandler, M., Clyde, M., McGreavy, B., Haklay, M., Ballard, H., ... & Gallo, J. (2017). Leveraging the power of place in citizen science for effective conservation decision making. Biological Conservation, 208, 55-64.

Nisbet, E. K., & Zelenski, J. M. (2013). The NR-6: A new brief measure of nature relatedness. Frontiers in Psychology, 4(813). https://doi.org/10.3389/fpsyg.2013.00813

Nisbet, E. K., Zelenski, J. M., & Murphy, S. A. (2009). The nature relatedness scale: Linking individuals' connection with nature to environmental concern and behavior. Environment and Behavior, 41(5), 715–740. https://doi.org/10.1177/0013916508318748

Notaro, S., Grilli, G., & Vaske, J. J. (2024). Demographics and wildlife value orientations: insights for managing wildlife in the Alps. Human Dimensions of Wildlife, 1-12.

Novacek, M. J. (2008). Engaging the public in biodiversity issues. Proceedings of the National Academy of Sciences, 105(supplement_1), 11571-11578.

O'Hare, A., Powell, R. B., Stern, M. J., & Bowers, E. P. (2020). Influence of educator's emotional support behaviors on environmental education student outcomes. Environmental Education Research, 26(11), 1556-1577.

Ostermann-Miyashita, E., Pernat, N., & König, H. J. (2021). Citizen science as a bottom-up approach to address human–wildlife conflicts: From theories and methods to practical implications. Conservation Science and Practice, 3(3). https://doi.org/10.1111/csp2.385

Panisi, M., Vasco Pissarra, Oquiongo, G., Palmeirim, J. M., Faustino, R., & Nuno, A. (2022). An endemic-rich island through the eyes of children: Wildlife identification and conservation preferences in São Tomé (Gulf of Guinea). Conservation Science and Practice, 4(3). https://doi.org/10.1111/csp2.12630

Peter, M., Diekötter, T., & Kremer, K. (2019). Participant outcomes of biodiversity citizen science projects: A systematic literature review. Sustainability, 11(10), 2780.

Peterson, M. N., Peterson, T. R., Peterson, M. J., Lopez, R. R., & Silvy, N. J. (2002). Cultural Conflict and the Endangered Florida Key Deer. The Journal of Wildlife Management, 66(4), 947. https://doi.org/10.2307/3802928

Peterson, M. N., Stevenson, K. T., & Lawson, D. F. (2019). Reviewing how intergenerational learning can help conservation biology face its greatest challenge. Biological Conservation, 235, 290–294. https://doi.org/10.1016/j.biocon.2019.05.013

Phillips, T. B., Ballard, H. L., Lewenstein, B. V., & Bonney, R. (2019). Engagement in science through citizen science: Moving beyond data collection. Science education, 103(3), 665-690.

Pitt, A. N., & Schultz, C. A. (2018). Youth-Based Citizen Science Monitoring: Case Studies from Three National Forests. Journal of Forestry, 116(2), 109–116. https://doi.org/10.1093/jofore/fvx008

Pooley, S., Bhatia, S., & Vasava, A. (2021). Rethinking the study of human–wildlife coexistence. Conservation Biology, 35(3), 784-793.

Powell, R. B., Stern, M. J., Frensley, B. T., & Moore, D. (2019). Identifying and developing crosscutting environmental education outcomes for adolescents in the twenty-first century (EE21). Environmental Education Research, 25(9), 1281-1299.

Prokop, P., Özel, M., & Uşak, M. (2009). Cross-Cultural Comparison of Student Attitudes toward Snakes. Society & Animals, 17(3), 224–240. https://doi.org/10.1163/156853009x445398

Prokop, P., Tolarovičová, A., Camerik, A. M., & Peterková, V. (2009). High School Students' Attitudes Towards Spiders: A cross-cultural comparison. International Journal of Science Education, 32(12), 1665–1688. https://doi.org/10.1080/09500690903253908

Rana, S., Ávila-García, D., Dib, V., Familia, L., Gerhardinger, L. C., Martin, E., ... & Pereira, L. M. (2020). The voices of youth in envisioning positive futures for nature and people. Ecosystems and People, 16(1), 326-344.

Richardson, M., Hunt, A., Hinds, J., Bragg, R., Fido, D., Petronzi, D., Barbett, L., Clitherow, T., & White, M. (2019). A Measure of Nature Connectedness for Children and Adults: Validation, Performance, and Insights. Sustainability, 11(12), 3250. https://doi.org/10.3390/su11123250

Rosa, C. D., Collado, S., & Larson, L. R. (2022). The utility and limitations of the New Ecological Paradigm Scale for children. Journal of Environmental Education, 53(3), 87-98. doi:10.1080/00958964.2022.2044281

Rosa, C. D., Fried, E. I., Larson, L. R., & Collado, S. (2023). Four challenges for measurement in environmental psychology, and how to address them. Journal of Environmental Psychology, 85, 101940. doi:10.1016/j.jenvp.2022.101940

Rosalino, L.M., Gheler-Costa, C., Santos, G. et al. Conservation priorities for elementary school students: Neotropical and European perspectives. Biodivers Conserv 26, 2675–2697 (2017). https://doi.org/10.1007/s10531-017-1380-2

Salazar, G., Ramakrishna, I., Satheesh, N., Mills, M., Monroe, M. C., & Karanth, K. K. (2021). The challenge of measuring children's attitudes toward wildlife in rural India. International Research in Geographical and Environmental Education, 1–17. https://doi.org/10.1080/10382046.2021.1897339

Salazar, G., Nitya Satheesh, Ramakrishna, I., Monroe, M. C., Mills, M., & Karanth, K. K. (2024). Using environmental education to nurture positive human–wildlife interactions in India. Conservation Science and Practice. https://doi.org/10.1111/csp2.13096

Schuttler, S. G., Sorensen, A. E., Jordan, R. C., Cooper, C., & Shwartz, A. (2018). Bridging the nature gap: can citizen science reverse the extinction of experience?. Frontiers in Ecology and the Environment, 16(7), 405-411.

Schuttler, S. G., Sears, R. S., Orendain, I., Khot, R., Rubenstein, D., Rubenstein, N., ... & Kays, R. (2019)a. Citizen science in schools: Students collect valuable mammal data for science, conservation, and community engagement. Bioscience, 69(1), 69-79.

Schuttler, S. G., Stevenson, K., Kays, R., & Dunn, R. R. (2019)b. Children's attitudes towards animals are similar across suburban, exurban, and rural areas. PeerJ, 7, e7328.

Shapiro, H. G., Erickson, K. A., Peterson, M. N., Frew, K. N., Stevenson, K. T., & Langerhans, R. B. (2016). Which species to conserve: evaluating children's species-based conservation priorities. Biodiversity and Conservation, 25(3), 539–553. https://doi.org/10.1007/s10531-016-1067-0

SHAPIRO, H. G., PETERSON, M. N., STEVENSON, K. T., FREW, K. N., & LANGERHANS, R. B. (2017). Wildlife species preferences differ among children in continental and island locations. Environmental Conservation, 44(4), 389–396. https://doi.org/10.1017/s0376892917000133

Skår, M., & Krogh, E. (2009). Changes in children's nature-based experiences near home: from spontaneous play to adult-controlled, planned and organised activities. Children's Geographies, 7(3), 339-354.

Skibins, J. C., & Powell, R. B. (2013). Conservation caring: Measuring the influence of zoo visitors' connection to wildlife on pro-conservation behaviors. Zoo biology, 32(5), 528-540.

Skupien, G. M., Andrews, K. M., & Larson, L. R. (2016). Teaching tolerance? Effects of conservation education programs on wildlife acceptance capacity for the American alligator. Human Dimensions of Wildlife, 21(3), 264-279."

Soanes, K., Cranney, K., Dade, M. C., Edwards, A. M., Palavalli-Nettimi, R., & Doherty, T. S. (2019). How to work with children and animals: A guide for school-based citizen science in wildlife research. Austral Ecology. https://doi.org/10.1111/aec.12836

Soga, M., & Gaston, K. J. (2016). Extinction of experience: the loss of human–nature interactions. Frontiers in Ecology and the Environment, 14(2), 94-101.

Soga, M., & Gaston, K. J. (2023). Global synthesis reveals heterogeneous changes in connection of humans to nature. One Earth, 6(2), 131-138.

Soga, M, Gaston K.J., Koyanagi, T.F., Kurisu, K., Hanaki, K, Urban residents' perceptions of neighbourhood nature: Does the extinction of experience matter? Biological Conservation, Volume 203, 2016, Pages 143-150, ISSN 0006-3207, https://doi.org/10.1016/j.biocon.2016.09.020.

Stevens, M., Rawat, S., & Satterfield, T. (2025). Care, conflict, and coexistence: Human–wildlife relations in community forests. People and Nature, 7(1), 231-246.

Szczytko, R., Stevenson, K. T., Peterson, M. N., & Bondell, H. (2020). How combinations of recreational activities predict connection to nature among youth. The Journal of Environmental Education, 51(6), 462-476.

Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. Research in science education, 48, 1273-1296.

Teel, T. L., & Manfredo, M. J. (2010). Understanding the diversity of public interests in wildlife conservation. Conservation biology, 24(1), 128-139.

Thomas, R. E., Bruyere, B., Sundaresan, S., Bouzo, S., Welden, R., & Trimarco, J. (2015). Youth experiences with wildlife during a period of significant cultural change in Laikipia, Kenya. Human Dimensions of Wildlife, 20(2), 133-146.

Thomas, R. E., Teel, T., Bruyere, B., & Laurence, S. (2019). Metrics and outcomes of conservation education: A quarter century of lessons learned. Environmental Education Research, 25(2), 172-192.

Vadala, C. E., Bixler, R. D., & James, J. J. (2007). Childhood play and environmental interests: Panacea or snake oil?. The Journal of Environmental Education, 39(1), 3-18.

Vaske, J. J., Jacobs, M. H., & Sijtsma, M. T. (2011). Wildlife value orientations and demographics in The Netherlands. European Journal of Wildlife Research, 57, 1179-1187.

Vaske, J. J. (2019). Survey research and analysis. Sagamore-Venture.

Weiss, E. B. (1990). Our Rights and Obligations to Future Generations for the Environment. https://scholarship.law.georgetown.edu/facpub/1627/

Whitburn, J., Linklater, W., & Abrahamse, W. (2020). Meta-analysis of human connection to nature and proenvironmental behavior. Conservation biology, 34(1), 180-193.

Woods, V., & Knuth, M. (2023). The Biophilia Reactivity Hypothesis: biophilia as a temperament trait, or more precisely, a domain specific attraction to biodiversity. Journal of Bioeconomics. https://doi.org/10.1007/s10818-023-09342-w

Yeshey R., Ford, R. M., Keenan, R. J., & Nitschke, C. R. (2023). Religious beliefs and wildlife value orientations influence tolerance of wildlife impacts in Bhutan. Human Dimensions of Wildlife, 1–19. https://doi.org/10.1080/10871209.2023.2234389