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Inviting the Public into Wildlife Research: Does Participation in Research Projects That Facilitate Interactions with Local Species Change Feelings of Connection?

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INVITING THE PUBLIC INTO WILDLIFE RESEARCH: DOES PARTICIPATION IN
RESEARCH PROJECTS THAT FACILITATE INTERACTIONS WITH LOCAL SPECIES
CHANGE FEELINGS OF CONNECTION?

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ABSTRACT

For many reasons, humans are less connected to nature. Research shows that people who feel more connected to nature are more likely to have pro-environmental intentions. Bridging the gap between humans and nature is critical to stem environmental degradation and influence care and empathy for wildlife, especially neighboring wildlife. One possible way to strengthen the human-nature connection is to involve the public in wildlife research, exposing them to local wildlife in a way that highlights science. A connection to the wildlife in their area could influence people to do more to protect the areas in which they live for an array of species. This dissertation is an investigation of two such projects, the 2019 Clemson Barred Owl Project and a 2023 Trout in the Classroom program, in order to understand the effects of interacting with local species through wildlife research.

Interviews were conducted with participants and the lead researcher of the Clemson Barred Owl Project in order to gain an understanding of the effects of participation in the project, and what aspects of the project made it especially successful at facilitating positive human-wildlife interactions. The participant study revealed that stronger connections with a local wildlife species were formed and this connection led participants to think more about their environmental impacts, leading them to more pro-environmental behaviors and a desire to advocate for the owls in their area, even five years after the conclusion of the project. Word of the project spread through the community and this research also provides a focused examination of the project's lead researcher and her approach that invited interaction and discovery. The interview with the lead researcher also uncovered aspects of the project and researcher which lead to the project's success in facilitating positive interactions between the public and wildlife. Some of these components included specific traits of the owls and the non-invasive nature of the

project which made close public involvement possible, the use of location data, community support, and some traits of the researcher including a patient, approachable manner, an enthusiasm for the target species and the research that can spread to participants, and proficient science communication skills.

The study investigating the effects of participation in Trout in the Classroom involved conducting interviews and surveys with students who participated in Trout in the Classroom in 2023 and surveys with teachers who use the program as part of their curriculum, also sent out in 2023. Investigating the students' experiences revealed some common outcomes of participation in the project including greater feelings of connection to the trout the students are raising, greater pro-environmental intentions, increased acknowledgement of responsibility, and awe for the complexity of the aquatic environment. Trout in the Classroom educators also revealed some additional common themes of the experience of participating in the project including enjoyment of the project and identifying closer with the role of "scientist." Additional interesting themes related to the educators' experiences were also found, including the fact that students feel like they learn alongside students and that some educators do not identify Trout in the Classroom as a strictly "science" based project.

These three studies demonstrate the potential that involving the public in wildlife science has for allowing positive interactions between people and wildlife, which can lead to a closer relationship between humans and their local wildlife and the growth of knowledge about the species and what it needs to survive and thrive. Involvement in these projects led naturally to thinking about the system wildlife is living in, not the species in isolation.

DEDICATION

This dissertation is dedicated to all of those who set me on, and helped me down, the path that I am on today as an educator, interpreter, and scientist.

First, I would like to thank my parents, without whom I would not be where I am today. Their support and many contributions have allowed me to discover what I am passionate about and pursue these interests as a career. I don't, and I'm not sure that I ever can, thank them enough.

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This work is also dedicated to the animals who I have met and worked with along my journey to this point. My interactions and relationships with animals have had a lot of impact on my life. Again, these are far too many to name, but I would like to acknowledge some in particular including the ambassadors I worked with at Lees-McRae College, Magnolia the opossum, Zeus the peregrine falcon, Hamlet the Northern saw-whet owl, and Charlie the blue jay. I also have to mention the many pets I have had along the way, especially those who have been with me throughout the dissertation process, including the furry; the dogs, Gibbs and Parker, and the cats, Winston, Salem and Lorenzo, and also the scaly; Cousteau the corn snake, Sunny the sunfish, and three very badly behaved turtles, Lettuce, Onion, and Tomato.

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This foundation was built upon by my other committee members in the Parks, Recreation, and Tourism department, Dr. Corliss Outley and Dr. Aby Sène-Harper. Dr. Outley exposed me to community-based research and made me think more about my positionality as a researcher. Her philosophy course stands out to me as among the most influential that I have ever taken. I see Dr. Outley as a great example of what a researcher and educator should strive to be, which is someone who is compassionate, understanding, and encourages thinking about how others experience the world different from yourself.

Dr. Sène-Harper exposed me to a wide array of qualitative methodologies that I had never even heard of before and the course that I took with her was extremely valuable when determining which methods were best for answering my research questions. My time in her class and my reading of her work have influenced the way that I think about how people interact with the natural world. I am extremely lucky to have had these three incredible women, who are exemplary researchers and educators, from the PRTM department to lead me as I worked on this dissertation, the most difficult project that I have tackled to date.

Dr. Kyle Barrett, my committee member from outside of PRTM, was also critical to this work as the questions he asked and the feedback that he provided has helped me remember and relate my work back to my roots in wildlife biology. Without him, I would not have thought of several concepts that show up in this dissertation would be missing and my understanding of the Clemson Barred Owl Project would not be as detailed as it is today.

I would also like to acknowledge Dr. Lauren Duffy, who provided valuable advice about navigating the dissertation process and some of the methods that I chose to use in this document.

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I must also give thanks to all of those who participated in my interviews and surveys, including Clèment, the participants in her project, and the students and teachers from the Trout in the Classroom study. This dissertation would literally be nothing without them. I am very thankful for all of their openness and willingness to interact and have a dialogue with me, someone who they had never met.

Last, and certainly not least, I have to acknowledge the barred owls who were captured as part of the Clemson Barred Owl Project and all of the trout who were raised by Trout in the Classroom programs in North and South Carolina in the past couple of years.They are important, not only because I was researching how the public's interaction with them changed them, but because they had such a big impact on the people who encountered them. They have acted as ambassadors for their species and have helped people connect with nature in entirely new ways.

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CHAPTER ONE

INTRODUCTION

As humans continue to encroach on the natural world, available habitat for wildlife shrinks and humans and wildlife come into contact more and more. Despite the growing contact zone, there is a disconnect between most humans and nature (Cazalis et al., 2023). Living disconnected from nature could result in less healthy and less happy people (Bratman et al., 2021) and more threats to wildlife and habitats (Bekoff & Bexell, 2010). Connection to nature can be defined broadly as an emotional and experiential bond with the natural world (Barragan-Jason et al., 2023). A strong connection with nature can be fostered through the formation of a strong, personal connection with wildlife. Connection with wildlife can be described in a similar manner to connection with nature, as an emotional bond with one or more species formed by experience (Vining, 2003). It has been shown that people who have close or frequent interactions with wildlife feel more connected to the species they have experiences with (Castillo-Huitrón et al., 2020). It makes sense that wildlife species that people live in close proximity to and may encounter regularly, whether that be through sight or sound, could be easier to connect with than distant species. People can easily become familiar with and attached to these local species when given the opportunity. Research has shown that species connection can lead to place attachment, which can lead to a greater want to protect the natural spaces they deem special (Folmer *et al.,* 2019). It is important to find new ways to create and strengthen these relationships, and one potential possibility is by inviting the public into, and including them in, wildlife research projects that are occurring in their areas.

There is a "Connectedness to Nature Scale" (CNS) that has been used in the past to try to understand peoples' level of feelings of connection to the natural world (Mayer & Frantz, 2004)

however, recently it has been suggested that this scale is more focused on intellectual understanding of nature and not emotional connection (Perrin & Benassi, 2009). For this reason, other methods of looking at this feeling of emotional connection are needed.

Wildlife research often involves close observation, or even physical interaction with wildlife, and these sorts of interactions, when done in a safe and controlled manner under the supervision of professional researchers, could give the public a greater familiarity with local wildlife species. Being involved in the research process during these projects has the potential to give the public unique, up close interactions with the species that live around them that they may only see or hear in passing, which may allow for closer relationships with these wildlife species and nature as a whole (Fox & Gee, 2019). While viewing wildlife in a captive setting can affect feelings of connection and pro-environmental intentions, it is unknown whether similar or stronger results are produce following more personal interactions that can take place during wildlife research projects (Skibins & Powell, 2013).

Giving the public more opportunities to have up close, supervised experiences with wildlife through inclusion in wildlife research has the potential to improve the lives of humans who participate. It is already well known that nature has restorative effects on human health (Hartig, 2021). Having a strong connection to both wildlife and nature as a whole has been shown to have numerous positive effects on human health and well-being (Mygind *et al.*, 2019). Those who spend more time in nature spaces and have greater connections to them have been shown to experience numerous benefits for their physical health, some of which include lower blood pressure (Lee *et al.*, 2011), faster times recovering from illness or injury (Ulrich, 1983), and many other health boons that seem to be beyond what one might expect from the physical exertion of doing activities in nature spaces alone (Richardson *et al.*, 2013).

Mental health can also benefit from nature connection and wildlife interaction. Stress and symptoms of multiple mental health diagnoses, including anxiety, can be reduced in people who are well connected to nature (Hartig et al., 2003). Both increased connection to nature and animal interactions have been shown to have this positive effect (Keenan et al., 2021; Chavez et al., 2023). Those who struggle with Attention Deficit Disorder, especially youth, have been shown to have reduced symptoms when they spend more time interacting with nature (Tillman et al., 2018; Di Carmine & Berto, 2020; Ohly et al., 2016).

As stated above, a connection to nature or wildlife can result in pro-environmental intentions (Liu et al., 2022). Children who are exposed to nature and wildlife early are more likely to be environmental activists (Wells & Lekies, 2006) or professionals (James et al., 2010) as adults and adults with solid nature connections have increased self-reported participation in pro-environmental behaviors (Rosa et al., 2018). Communities of people who care more about the environment, likely in part due to these connections, can begin to come together and advocate for more widespread environmental action (Geiger et al., 2019).

There are a multitude of reasons why the disconnect between humans and nature may be growing. Ives *et al*., (2018) describes five dimensions of connection to nature and gives examples of how loss of connection can occur in each of these categories. These dimensions are material, experiential, cognitive, emotional, and philosophical. The material dimension deals with the extraction and use of natural resources. The experiential dimension deals with people's experiences and time spent in nature. The cognitive dimension deals with the attitudes and values that people have pertaining to nature. The emotional dimension deals with the emotions that people associate with nature (such as happiness, curiosity, or fear). The philosophical dimension deals with different conceptualizations of a person or group's relationship with the natural world.

Of these dimensions, all but material disconnects can be traced back to humans spending less time in nature and less time observing or interacting with wildlife. Changing lifestyles that rely more and more on technology and development (Hailwood, 2016), people spending less time in the outdoors (Soga & Gaston, 2018), and lack of environmental literacy (Andersson & Barthel, 2016) are some of the many reasons cited for increasing gap between humans and the natural world. A lack of knowledge about the environment could be contributed both to people spending less time interacting with nature than they have historically, as well as to a growing distrust in science, including institutions or agencies that monitor or manage wildlife (Činčera et al., 2023; Manfredo et al., 2017).

Many now describe a "war on science" taking place in the United States (Foley 2017; Hardy *et al.*, 2019). Some have cultural reasons to distrust science (Scharff et al., 2010), but the level of trust that the public has in science has dropped drastically across the board (Brian et al., 2012). This massive drop in scientist's perceived credibility, whatever the cause, can be dangerous. Being more included in the research and decision-making processes is one possible way that some of this trust may be regained (Funk et al., 2019). The public is being included more often in the wildlife management process, but this inclusion, along with the inclusion of public in the wildlife research process, is still not the norm (Pomeranz *et al.,* 2021). This inclusion is an invitation to science and an invitation to connect with wildlife and nature through science, but is only an opportunity with a trust in and appreciation for science.

By inviting the public to participate in research, professional scientists are accomplishing multiple tasks. The practice could act as a sort of "quality control", ensuring the public that best practices are at work. Any time the public is participating or observing the research process, there is a sort of democratization at work (Lindhult, 2022). By getting a better understanding of

the research process and being allowed to provide their voice in discussions on wildlife conflict or management issues, the public can be reassured to some degree that the decisions that are being made have the best interest of their communities, as well as the interests of the wildlife that they may have a form of connection with, in mind (Kadykalo et al., 2021; Treves et ial., 2021).

Professional wildlife researchers should take note of the potential benefits of connecting people and their research, as well as connecting people and wildlife, especially local wildlife. A public that understands and is concerned with their cause could be more likely to participate in behaviors that reduce conflicts, threats or improve conditions for their study species (Abrams et al., 2020) and potentially contribute more money into conservation when able (Lundberg et al., 2019). By connecting the public more with wildlife by inviting them be a bigger part of wildlife research, researchers have an incredible opportunity to strengthen the public's connection to the natural world (Vasiliades et al., 2021). By involving and informing the public, the discipline of wildlife biology could create many more advocates for wildlife (Johnson et al., 2014) and even lead to increased participation in advocacy for nature and wildlife (Bosso, 2003).

Advocacy, or the process of supporting a cause (in this case wildlife) (Minnis & McPeake, 2001), is essential to wildlife research, as it provides an avenue for research findings to be translated into real-world action. Advocacy helps to ensure that research is structured and implemented in a way that makes the most impact, and that resources are allocated to where they are needed most. Additionally, advocacy sends a strong message to government officials, researchers, and the public at large that wildlife research is a priority and that meaningful changes need to be made in the research and political process in order to protect wildlife and their habitats. Without advocacy, wildlife research often remains inaccessible to the public and underfunded, leading to limited progress in the protection of vulnerable species. Although it has

been shown that including the public in wildlife management has positive effects, as it can more evenly distribute the power when it comes to decision-making, perception of including the public in wildlife research is more complicated (Lute & Gore, 2014). Gaining a better understanding of the outcomes of this process is warranted, as a better knowledge of what could be gained could lead to the more deliberate planning of these projects in the future. Meaningfully designed experiences could very well make for more meaningful and informed connections.

Literature Review

It is well documented that people can develop strong connections to non-human animals. People experience connection in many ways, but they most often explain their feeling of connection as an "emotional, personal, or spiritual bond" (Vining, 2003). Another definition of connection to nature defines it broadly as an emotional and experiential bond with the natural world (Barragan-Jason et al., 2023). Despite most cultures drawing a line between humans and the natural world, it is impossible to escape people's connection to animals, whether that be as pets, as animals at the zoo, as wildlife they see in their daily lives, and even as other beings of spiritual importance (Shepard, 1993).

All these connections are important, but this research focuses on wildlife, connections that are much less studied than connection with companion animals. When people view wildlife species in captivity, there have been measured feelings of connection that typically increase when visitors view animals. Howell et al., made an effort to better define the "connection" that people feel with animals in zoos (2019). The results of their survey were used to identify five common themes of zoo visitor's meanings of connection. Their themes included "appreciation of the animal, attribution of mental states to the animal, inspired emotions in the visitor, interaction with the animal, and proximity to the animal." These common themes support other studies on

how people connect with animals. Other studies often describe close proximity, interaction, and emotional connection as important elements of the human-wildlife connection (Minarchek et al., 2021).

It has also been shown that this connection can cause people to have more pro-environmental intentions (Skibins & Powell, 2013). The literature also describes connections made with wildlife in situ. Folmer et al. studied the connections people feel with local species they encounter regularly in green spaces near their homes using informal walk-along interviews (2019). By merely seeing and hearing these species, participants showed strong emotional bonds with common local species, such as songbirds, deer, and insects. These wildlife connections were even strong enough that they caused participants to become more attached to their local green spaces, showing stronger place attachment to the areas their favorite local species called home. If this increase in place attachment is universal, then this information is of the utmost importance to this research.

Evidence shows that those who feel more attached to a place, specifically natural places, are more likely to have the intention to take actions towards protecting and conserving that environment (Xu & Han, 2019; Qiu et al., 2022). Studies that examine the connections made when people have a direct, face-to-face experience are more rare, and are mostly done abroad and/or in cases of human-wildlife conflict (Bortolamiol et al. 2018; König et al. 2020). Studies showing how participants' feelings of connection to local species through participation in science is even less discussed and what research does exist focuses on citizen science, however what the research does show is that participants can come out of those projects with increased scientific knowledge and a closer connection with nature as a whole (Toomey et al., 2020; Peter et al.,

2021). There is a gap in the literature regarding connections with local wildlife made or changed by interactions with them during the process of scientific research.

Citizen science can be described as scientific research in which data is collected or monitored by "amateur or non-professional" scientists (Haklay et al. 2021). As previously described, involvement in citizen science can leave participants with increased scientific knowledge and pro-environmental intention. Given the fact that citizen science is contributory in nature (involving the gathering, manipulation, and/or classification of data that is typically analyzed and interpreted by a professional scientist). What can be said about the involvement of the public in wildlife science is that there are complicated outcomes in the literature. As far as effects on members of the public go, there are some described in the literature however, they come from varied cases (online web-based projects, hands-on in person projects, etc.) and from all over the world. e. Some ways of collecting citizen science data have been shown to be very reliable. Studies involving online projects that aggregate citizen science observations (i.e. eBird, iNaturalist, etc.) show them to often be accurate. Projects which enlist the help of those who are especially dedicated to particular groups of wildlife (including hobbyists such as insect collectors and birdwatchers) also appear to produce good data (Kosmala et al., 2016). On the other hand, some studies report low quality data from citizen science observations. A general criticism of citizen science is that citizen scientists can have limited training and knowledge, which can lead to poor and potentially misleading observations (Alabri & Hunter, 2010). Because of this, a number of researchers completely discount citizen science, believing that the members of the public who volunteer in these projects cannot be held to the same scientific standards as professional scientists. While the benefits of citizen science are lauded much more in the literature, there are a handful of examples that seem to represent the worries of inaccuracy. This

sort of error can also lead to skewed datasets. With some researchers disagreeing on the reliability of citizen science data, it warrants asking whether or not citizens should be involved in wildlife science alongside professional scientists at all. If their reliability is undetermined, why would the wildlife researchers invite them in, not just for citizen science projects, but for any sort of participation at all?

For one, there are the previously discussed benefits that people get from participating in the research process. There are also proven benefits to letting the public be involved. Paramount is the fact that members of the public have knowledge about the world around them. A few researchers can come into an area and make observations, but the people who live there have often been seeing the species around them for their entire lives, if not for generations. The knowledge of local people has long been ignored, even longer so the knowledge of indigenous peoples, in favor of the codified scientific process (Mason et al., 2012). When local people are allowed to interact with and give their input to wildlife management, it makes the process more equitable and democratizes the process (Decker et al., 2019). Amateur scientists can even make observations that professional scientists miss. There are well-known historical examples of this, such as the local knowledge of extant coelacanths (*Latimeria sp.*) by fisherman. These fish were thought to be extinct for millions of years until their rediscovery by Western science in 1938 (Smith, 1940). These are all proven benefits to wildlife science and management, but there could potentially be many more that have not been studied yet, including the focus of this research.

Some principles of interpretation could also be useful if applied to wildlife research. Freeman Tilden, who is viewed as the father of what we now call interpretation, developed six principles of interpretation based upon his years of experience working with the National Parks Service (Tilden, 1957). These principles include the following:

1. Interpretation that does not somehow relate what is being displayed or described to something within the personality or experience of the visitor will be sterile. Interpretation should be personal to the audience.

2. Information, as such, is not interpretation. Interpretation is revelation based upon information. Successful interpretation must do more than present facts.

3. Interpretation is an art, which combines many arts. Any art is to some degree teachable.

4. The chief aim of interpretation is not instruction, but provocation. Interpretation should stimulate people into a form of action.

5. Interpretation should aim to present a whole rather than a part. Interpretation is conceptual and should explain the relationships between things.

6. Interpretation addressed to children should not be a dilution of the presentation to adults, but should follow a fundamentally different approach. Different age groups have different needs and require different interpretive programs.

Tilden's principles emphasize the importance of providing meaningful and interesting experiences for people to engage with. By connecting the natural world to human experiences, the public can gain a deeper understanding of the wildlife research process and its implications. Interpretive techniques like storytelling, interactive activities, and visuals could be used to create an immersive experience and make the research process more accessible. Additionally, by providing clear and relevant information, people can become more informed and have a better opportunity to connect with the research process and its results. Ultimately, applying Tilden's principles of interpretation is an effective way to deepen the public's understanding and appreciation of wildlife research and its results.

Theoretical Framework

This research is grounded in the knowledge that when people have an emotional connection to something, they are more likely to take actions to improve or protect it. A strong connection to nature has been shown to correlate with stronger pro-environmental intentions (Rosa et al., 2018). The disconnect could therefore lead to less pro-environmental action, which has the potential to lead to the further degradation or destruction of the environment. This in turn has the potential to further widen the gap between people and nature, as less or lower quality nature spaces can make it more difficult for people to form meaningful connections to the natural world. in an environmentally destructive negative feedback loop. If this loop is to be closed, there is a need for stronger connection and understanding made between people and nature, and a logical place to begin is by making connections with the species of wildlife that residents can see in their own communities. Strengthening the connection between humans and nature could lead to an adverse positive feedback loop, which has the opposite effects of the aforementioned negative feedback loop. A strengthened connection to nature makes people more likely to participate in pro-environmental actions. More environmental action means less environmental degradation, leaving more and better nature spaces for the public to access. These loops are illustrated in Figure 1. These relationships form the foundation of this dissertation. Understanding how participation in wildlife science can build connections and what aspects of wildlife science projects have the greatest potential to build these connections can help those concerned with wildlife conservation make the greatest impact on the environment and people's relationship with nature.

Figure 1.

Connection to Nature Feedback Loops
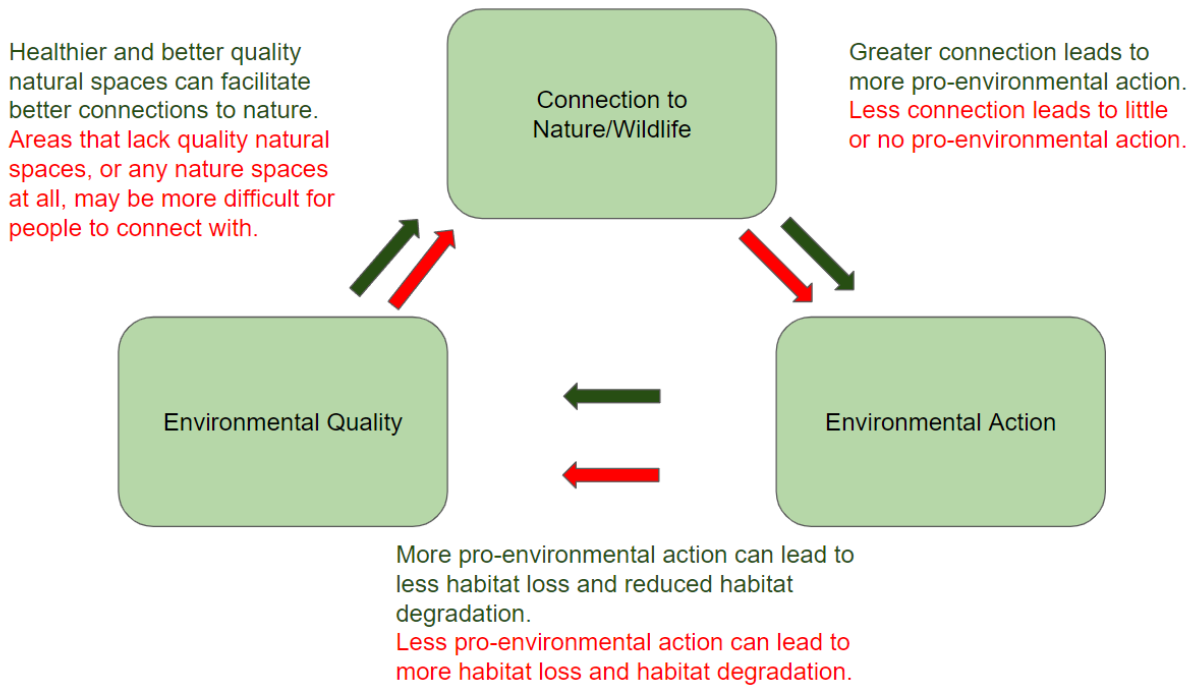
Healthier and better quality natural spaces can facilitate better connections to nature. Areas that lack quality natural spaces, or any nature spaces at all, may be more difficult for people to connect with.

Greater connection leads to more pro-environmental action. Less connection leads to little or no pro-environmental action.

Connection to Nature/Wildlife

Environmental Quality

Environmental Action

More pro-environmental action can lead to less habitat loss and reduced habitat degradation. Less pro-environmental action can lead to more habitat loss and habitat degradation.

Note. The green arrows and text outline the positive feedback loop and the red arrows and text outline the negative feedback loop. The concepts in the boxes in this graphic are increased in the positive feedback loop and decreased in the negative feedback loop.

The positive feedback loop described and illustrated may lead the public towards a more ecocentric way of thinking. Ecocentrism is a perspective that is based on Aldo Leopold's concept of "land ethic", which dethrones human beings as rulers over the environment and instead places them as members of the "land community" with an obligation to protect and respect the other parts of the community (Callicott, 1993). Ecocentrism seeks to take this view and expand it beyond the local to the global, combining the idea of land ethic with the teachings of ecology on a worldwide scale. There is the potential that, by connecting humans and wildlife in their local

areas by involving them in the wildlife research process, that this connection can expand their sphere of ethics and make them think about their impacts on a much larger scale

Shirk et al. (2012) examined types of public involvement in scientific research. In this research they describe five categories of participation. These five are the following: 1) contractual projects, in which communities ask researchers to conduct a study, 2) contributory projects, where the public contributes data, 3) collaborative projects, which lets the public contribute, refine project design, analyze data, and communicate results, 4) co-created projects, where the public works together with researchers in all aspects of the project, and 5) collegial contributions, wherein non-professional researchers conduct research independently of professional research. Just as this research falls outside of a citizen science framework, so to does this research fall outside of the categories described by Shirk (2012).

This dissertation represents a 6th category, which involves public observation and interaction with researchers during a project without actually participating in the direct collection or analysis of data. This category could be thought of as "contemplative" projects. In contemplative projects, individuals can engage with research and researchers through observation and minor levels of participation. The word "contemplative" was chosen to focus on the primary benefit of this sort of involvement, which are the individual reflections that participants can undergo after their experience. An immersive experience in the research process, without active participation, could provide a greater personal understanding and appreciation of science. This potential sixth category of participation could be used alongside the previously described categories, possibly in a greater frequency since it does not require any training of participants, than other categories like contributory, collaborative, or co-created, in order to get the public more involved in wildlife science and decision-making.

Methodological Approach

This research is firmly rooted in the epistemological perspective of constructivism, because it follows the notion that people's "truths" are developed through their own personal experiences and interactions (Willig, 2016). In the case of this study, those interactions are between humans and some of the species of wildlife that live locally, essentially. Social constructivism posits that a person's reality is defined by their relationships and interactions with other people (Amineh & Asl, 2015). This research could be thought of as a sort of cross-species social constructivism. Research centered around these concepts is well answered by qualitative research and, in particular, phenomenological research.

This research also takes the ontological position of relativism. Relativism posits that there is no one single true reality, but that multiple realities exist based on "multiple, intangible mental constructions" (Moon & Blackman, 2014). People's experiences are unique to a degree, which means that the way that people view subjects and experience situations are subjective in nature. The qualitative methodologies used in this research seek to better understand these different experiences in order to find out what, if any, universal themes may exist between these diverse experiences. There may not be one single universal truth, but there may be some components of experiences that may be found across multiple peoples' "pluralistic realities."

Phenomenological research is based upon the fact that "truth" exists within an individual's mind and perception, stemming from their experiences instead of just being observable from their experiences alone (Hanford, 1975). There are two types of phenomenological research; descriptive and interpretive (Tomaszewski *et al.*, 2020). Descriptive phenomenology deals with describing the essence of an experience. If common themes can be found in the thoughts and feelings of several participants, these may be considered some of the

universal traits of a particular experience. The use of phenomenological research focuses more on an individual's internal sense of "reality" more so than more empirical approaches to research. Since this research focuses on the personal experiences of participants who are being involved in the science, phenomenological research methods, specifically descriptive phenomenology, are the most logical choice.

The goal of this research will rely on making meanings about peoples' associations with local wildlife that they form based on participation in wildlife science out of the data collected. Meanings can be defined as "the cognitive categories that make up one's view of reality and with which actions are defined" (Krauss, 2005). Information gained from interviews and surveys will be the main source of data for this research and these details of participants' personal feelings about their experiences should be rich sources from which to pull their thoughts on meanings, specifically on their feelings of connection to wildlife in order to better understand how inviting the public to get involved in wildlife science may change how they view and relate to the natural world.

Trustworthiness

Confirming the trustworthiness of this data is paramount as without verification the data gathered by these processes may incorrectly reflect the experience of those interviewed or surveyed. Trustworthiness in research can be simply defined as "methods that can ensure one has carried out the research process correctly" (Eldridge, 2007). Essentially, having trustworthy data means that the data has reliability and validity. In the case of the studies outlined in this dissertation trustworthiness was addressed through multiple methods. These include the recording, transcription, and formal analysis of data which ensures that the data gathered from participants is reflective of participants' actual input. Recorded interviews were transcribed using

the Otter.AI transcription service and confirmed by a researcher, and both interview and survey data were analyzed using MaxQDA qualitative coding software. Some interviews in the studies were attended by a more experienced researcher in order to determine whether or not questions were applicable and that interviews were being conducted in a proper manner. Additionally, a traceable trail of research proposals, researcher notes, and dissertation drafts exist, providing an auditable history of the research.

Problem Statement

Since the disconnect between humans and wildlife has massive potential negative effects on human health and the environment, it is critical that new methods are found to strengthen humans' connection to nature and wildlife. Knowing, having experiences with, and being knowledgeable about, wildlife has been shown to build connection and foster pro-environmental intentions, a greater involvement of the public in wildlife research could be a largely unexplored avenue for bridging the human-nature gap.

Previous research has investigated the possible benefits of nature connection and wildlife interaction; there is a gap in the literature related to how this connection is affected by public participation in the wildlife research process. Inviting the public into research projects could not only encourage more environmental responsibility but could create advocates out of participants who trust in science more and fight for wildlife related causes. Understanding if and how connections can be strengthened by including the public in wildlife research could give wildlife researchers ideas on how to more deliberately design research projects that maximize connection and could create an environmentally engaged public.

Purpose Statement

The global goal of this dissertation is to better understand how interaction with local species, specifically through participation in research, can affect how the public think about and interact with the natural world around them. In order to reach this goal, the research will investigate public participation in two projects related to wildlife research in the upstate of South Carolina and an in-depth interview with a wildlife researcher who has demonstrated an ability to facilitate meaningful connections between the public and wildlife.

This dissertation seeks to explore how participation in wildlife research process impacts people who may otherwise not have any other in-depth knowledge or interactions pertaining to wildlife in their area, and seeks to understand how their connections to the animals living around them changes. Since previous research has shown a correlation between connectedness and pro-environmental ideas, the fostering of these sorts of meaningful connections is becoming critical in a time where so many aspects of the natural world are in decline.

This research examines what, if any, connections are made between humans and wildlife when members of the public interact with a local wildlife species during the course of a wildlife research project. A better understanding could also be reached of how pre-existing connections could be strengthened by project involvement. New information on these connections and the changes in behavior that they could lead to could be found by using the literature to interpret qualitative data, including interview and survey data, gathered from people who have been involved directly in science projects related to wildlife.

Through an examination of the two community involved projects the following research questions will be examined:

RQ1:How does in situ participation in the wildlife research process change participants' relationships with local wildlife?

RQ2: What components of the Clemson Barred Owl Project made the project particularly well-equipped to facilitate meaningful human-wildlife connections?

RQ3What traits of the primary researcher of the Clemson Barred Owl Project made the researcher particularly well-equipped to facilitate meaningful human-wildlife connections?

RQ4: How does participation in a classroom project based on a local species affect participants' feelings of connection to local wildlife?

Location Note

The two focal projects for this research are in proximity with one another, all occurring in the upstate of South Carolina (an area well known for its natural areas), with only a portion of the teachers who participated in the Trout in the Classroom teacher survey who were located in North Carolina. By looking at multiple projects occurring in the same locality, it may be possible to better understand how one area can benefit from the more widespread inclusion of the public in wildlife research.

Role of the Researcher

For the past decade I have been involved in both wildlife/fisheries research and environmental education. My responsibilities have included both the research and communication of issues facing fish and wildlife, as well as providing the public with unique opportunities to have up close and interactive experiences with animals. Giving people these very personal experiences with wildlife elicited stronger reactions and more passionate responses than anything else that I have been a part of. This research is framed by my interpretive

experiences and the literature that outlines why these programs have the potential to be so successful. Finding new ways to help wildlife researchers give the public experiences which help them build emotional connections with nature, which may foster new passions for protecting wildlife is the overarching goal of this research, as well as a personal and professional goal of mine.

Positionality

A researcher's positionality will always affect the way that they interact with and perceive research subjects. Understanding your own positionality is especially critical in community-based research due to your direct interaction with the community and the potential power imbalances that could come with this when your own internal biases are not fully understood.

I understand that I have multiple identities that have given me privilege. I used social identity mapping as a tool to help me identify the different facets of my social identity and how they may affect my views (Jacobson & Mustafa, 2019). I am white, able-bodied, middle class, a natural born citizen, and male. Another privilege that I have is my advanced level of education, which was likely much easier for me to achieve due to the previously listed privileges. All of these privileges have affected who I have become as a person. My life has been quite comfortable and I have not often had to worry about my safety or financial stability. These privileges could benefit me as a researcher. I could be respected more simply because of these things (not because I have earned it) and it could be easier for me to navigate some institutional structures, but it is not important to understand your privileges because of what you can get out of them. It is important to understand them because of how they can tint the way you see and interact with the world. In reality, my privileges, at least partially, blind me to how the people

outside of my social identities live. The experiences and daily struggles of marginalized peoples are not familiar to me. I can seek to better understand them, but I can never fully know them unless I am a member of these identities.

Specifically, as a researcher, I know that my identity and experiences affect how I view methodologies and the interpretation of data. My background is in natural science, but I am currently working in the social science field. This may tempt me to hold quantitative methodologies as more reputable, or more "real", than qualitative, and as previously stated, the privileges related to my social identity limit my understanding of the struggles of others.

My positionality is also rooted in Western academic tradition. My understanding of nature and my perspectives on connection with it are affected by this background. This approach heavily prioritizes empirical methods and to a degree views nature as something to be controlled. Western views typically put a degree of separation between humans and the natural world, like the gap this study seeks to decrease, and sees humanity as greater than, responsible for dominating and being stewards over nature.

My training has shaped my views on research and the natural world. The methodologies and frameworks that I use to understand the world seek to find some sort of universal application or meaning. This way of thinking does not tend to acknowledge Eastern and indigenous ways of thinking and knowing. Eastern and indigenous perspectives often integrate humans and the natural world, seeing both as dependent and connected with each other. My chosen methods have opened up this line of thinking for me through research and may lead to amplifying these perspectives in the future.

I acknowledge my bias towards Western academic ways of thinking and knowing and understand that there may be gaps in the way that I understand the natural world based on this

bias. This research uses methodologies based in this way of knowing, but I aim to keep in mind that there are other ways to answer the questions that I ask and remain open to these ways of understanding the world. It is my hope that future work in this subject challenges the Western paradigms that are so dominant in academia today and incorporates a more diverse range of voices that can help science develop more effective and respectful solutions to today's environmental challenges.

I am committed to being open about how my social identity can affect my views of the world and my role as a researcher. Transparency is an important trait for every researcher to have. Without identifying and communicating the biases that you may have you are likely limiting your research and tainting the results and the effect on the community. When co-creating with a community everyone must be able to feel comfortable and on the same playing field. Privileged researchers who do not understand how their background can affect their positionality have the potential to do damage in community-based research. Benefits and burdens can be distributed unequally and power imbalances can be made worse. To avoid this situation, I will now and in the future acknowledge the impact that my positionality can have on my work with others, and I will consider the identities of those whom I will be working alongside, treating them as equal partners.

Structure of the Document

The remainder of this document following this introductory chapter will be comprised of four chapters. Chapter 2 will investigate the experiences of members of the public who were given the opportunity to learn about the research process and have close interactions with a local species during the course of a wildlife research project. Chapter 2 will address the following research question:

RQ1: How does in situ participation in the wildlife research process change participants' relationships with local wildlife?

Chapter 3 consists of the examination of an exemplary wildlife researcher who designed and carried out a research project on barred owls that sought to involve the public and create a community around the project. This chapter will address the following research question:

RQ2: What components of the Clemson Barred Owl Project made the project particularly well-equipped to facilitate meaningful human-wildlife connections?

RQ3: What traits of the primary researcher of the Clemson Barred Owl Project made the researcher particularly well-equipped to facilitate meaningful human-wildlife connections?

Chapter 4 will investigate how students' feelings of connection to nature may have changed following involvement in a classroom project that required the raising and monitoring of a locally found fish species. This study will answer the following research question:

RQ4: How does participation in a classroom project based on a local species affect participants' feelings of connection to local wildlife?

Chapter 5 will discuss the dissertation as a whole and offer implications and potential future directions for research.

DEFINITIONS

Citizen science- Scientific research in which data is collected or monitored by "amateur or non-professional" scientists (Haklay et al. 2021).

Connection- An emotional bond based on experience (Vining, 2003)

Conservation- Proper management of human impact on the environment so that it yields the "greatest sustainable benefit to current generations" while still being able to meet the needs of future life (World Resource Institute, 1992).

Ecocentrism- A viewpoint that emphasizes the importance of the global environment (Callicott, 1993).

Interpretation- "an educational activity which aims to reveal meanings and relationships through the use of original objects, by firsthand experience, and by illustrative media, rather than simply to communicate factual information" (Tilden, 1957).

Land Ethic- The perspective that humans, as part of the environment, have an obligation to do what is best for the natural world (Leopold, 1949).

Pro-environmental Intention- Intention to participate in future environmentally sustainable behaviors.

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CHAPTER TWO

BUILDING A COMMUNITY OF CONSERVATION: THE EFFECTS OF INVITING THE PUBLIC TO PARTICIPATE IN WILDLIFE RESEARCH

Abstract

Wildlife research projects may have the potential to build public engagement in wildlife science as well as the literature. In the Spring of 2019, a research project was conducted by a Clemson University graduate student which involved the capturing barred owls and attaching GPS transmitters in order to investigate what features facilitate their presence in developed areas. The project had a public involvement component which consisted of capturing the owls on private property and inviting landowners and other members of the community to observe and interact with the owls. Semi-structured interviews were performed with participants in the project to understand how their participation affected their feelings of connection to the owls. Stronger connections with local wildlife have the potential to increase pro-environmental ideals which may lead to positive conservation outcomes. The results of these interviews suggest that participation in the project facilitated emotional connections with the owls and led to pro-environmental intentions. The project built a "community of conservation" in which those who participated in the project shared their positive experience with the project and new environmental knowledge with other people in the community. The results of this study suggest that adding public involvement components to wildlife research projects can connect people and wildlife and create environmental stewards.

Introduction

Understanding how humans have impacts on the natural world and the connections that people have with nature is more than just an educational exercise, it is critical to ensure environmental health and human wellbeing. The reality that everyone has some sort of impact on the environment is at the heart of conservation and not everyone considers this without some sort of provocation (Rough, 2021). Connecting the public and nature is a crucial step towards making people think more about the environment and instill a conservation ethic. This research examines the effect of inviting the public to participate in wildlife research. It also seeks to understand what the interaction with a local wildlife species through a research project may have had on their feelings of connection to nature. Since connections to nature and wildlife have been demonstrated to result in pro-environmental intentions (Rosa *et al.*, 2018), understanding how these connections could be built and strengthened could provide insight on how to best incorporate public involvement into wildlife research.

In the Spring of 2019, a Clemson University Wildlife and Fisheries Biology Masters student, Marion Clément (advised by Dr. Kyle Barrett), performed a study that involved calling in, capturing, and attaching GPS transmitters to Barred Owls (*Strix varia*) to investigate key features that facilitate their presence in developed areas. To locate additional owls for the study researchers reached out to the community through a variety of methods including "social media, news publications, and fliers" (Clément *et al.* 2021). Multiple reports came in to the research team from local homeowners who were having frequent sightings of Barred Owls on their property. Once a homeowner stated their willingness to participate in the project, the lead researcher, Marion Clément, would come to visit the property. An attempt to lure a barred owl to the property using recorded conspecific calls was the first step. If this was successful then the

homeowner would be informed, and the process of the research was described, including that the nights they were calling in and feeding the owl to train it for capture would require all residents of the home to be indoors and quiet. The process took one week for approximately 30 minutes per night. On the final night the owl was netted. Captured owls went through a full work-up involving data collection, which included the collection of blood samples, the taking of various measurements, and feather aging, as well as the attachment of a battery-powered GPS transmitter.

That night the homeowners, neighbors and friends could quietly watch the measurements performed, name their owl and then three people could/hold touch the owl, under the guidance and supervision of Clément. This project was successful in gathering meaningful data on barred owls, and also, in getting members of the public invested in wildlife research. The homeowners, their families, and maybe even close friends and neighbors were often invited to watch and occasionally get involved in the process by helping with taking measurements or holding owls. Participants were even allowed to release their owls after the data collection process. This is an interesting opportunity for most as owls are not typically seen up close, as they are nocturnal, fly silently, and tend to avoid humans. The rare chance to see and even help hold an owl is a novel one for most.

The unanticipated result of the Clemson Barred Owl Project was the overwhelming interest the homeowners and others had in the owls and the science. Anecdotal evidence that the barred owl project had some sort of positive effect was encountered by researchers multiple times but was not examined as a part of the research focused on how the degree of human development in an area influences the home range size of barred owls and what habitat features they most closely associate with (Clément *et al.* 2021).This research is designed to return to the

participants five years later to determine what, if any lasting effects from participation exist, as well as reflections on the experience of participating in the owl study and interacting with wildlife science. This research aims to address a gap in the literature regarding the effects of close interaction with an animal during a wildlife research project. This program clearly built what could be defined as a "sense of community" around it as, despite less than 20 properties being utilized for the luring and capture of owls, the "Clemson Owls" Facebook page, which was created and managed by the main researcher of the owl project for the purpose of communicating with the public about the project, has accumulated over 500 followers. With this level of following, it is clear that some level of community buy-in has occurred.

The inclusion of the public in wildlife research examined here will be referred to as public involvement or public participation in research. Citizen science is a participatory act but it is a "practice in which people mostly contribute observations or efforts to the scientific enterprise" (Cooper and Lewenstein, 2016). This term does not apply to the type of participation in this project, as participants made no contributions to the data aside from providing researchers with possible owl capture sites. In citizen science data can be collected or analyzed by the public, but in this study the science was clearly the responsibility of the scientist, not the members of the public involved. Although participants' properties were needed for this project, it was not required that the public be included in the process to the degree that they were. Those present for the luring and capture of owls were allowed to observe the process, hold captured owls, and assist with owl release, but owls were initially captured and data was collected by professional researchers. Citizen science could fall under the umbrella term of public involvement in research, but the reverse is not true. Citizen science projects can be especially effective in many situations, such as projects where dedicated hobbyists, like birdwatchers

(Kosmala *et al.*, 2016) or "herpers" (those interested in reptiles and amphibians) (Price & Dorcas, 2011) are involved, but there have been a number of notable critiques to utilizing citizen science in wildlife research, including unstructured or inaccurate data (Chesser, 2012) and the possibility of contention over what observations are "important between citizen scientists and professional researchers (Woodcock *et al.*, 2017). These factors have made some question whether or not citizen science is worth it for researchers to consider as a viable option (Hunter *et al.*, 2013). Considering ways that people could get involved in science besides what is considered citizen science, such as the activities that the public participated in as part of the barred owl project, and understanding the effects of this involvement could lead to new ideas about how to design these projects to maximize participant connection and buy-in.

The purpose of this research is to gain a more robust understanding of how members of the public who were invited to be a part of the Clemson Barred Owl Project had their perceptions changed by the experience, Specifically we seek to answer the following research question: How does in situ participation in the wildlife research process change participants' relationships with local wildlife?

Methods

Approach to Research

This research uses interviews with members of the public who were invited to observe and interact with the Clemson Barred Owl Project. This research uses the epistemological frameworks of constructivism and phenomenology to build an understanding of the "invariant" essence of the experience that is still being described five years after the culmination of the project and an examination of reflections on the meaning of the experience long after the end of the project. Attention will be paid to the overlap of the experience for most or all participants.

This study and the Clemson Barred Owl Project took place around Pickens County, South Carolina, and more specifically, the greater Clemson area. Homeowners that participated in the Clemson Barred Owl Project were located in the towns of Clemson, Central, Pendleton, and Seneca. This area is home to Clemson University and contains multiple residential and commercial areas. The area is a mix of rural farms and forests with a series of lakes formed by multiple dams on the Keowee River. The area is home to the Clemson Experimental Forest, a 17,500 acre working forest with a mix of forest types from loblolly pine for harvest to mixed hardwoods and meadows.

Demographic data for Pickens County, South Carolina (U.S. Census Bureau, 2020) can be found in Table 1.

Table 1. 2020 United States Census data for Pickens County, South Carolina.

Factor	Measure
Total Population	
Total Population	133,470
Age & Sex	
Under 5	4.6%
Under 18	18.3%
Over 65	17.4%
Female	50.0%
Male	50.0%
Ethnicity	
White	88.5%
African-American or Black	7.2%
American Indian or Alaska Native	0.3%
Asian	2.0%
Two or More Races	2.0%
Hispanic or Latino	4.6%
Other Information	
Foreign Born Person	3.5%
Housing Units	58,645
Average Number of People Per Household	2.45
Language Other than English Spoken at Home	4.9%
High School Graduate or Higher	87.1%
Bachelor's Degree or Higher	27.5%
Median Household Income	$57,628
People Per Square Mile	264.4

Data Collection

Participants in the barred owl project were contacted using information (phone number or email) that was taken during the initial project. The information was provided by the researchers who led the barred owl project. Out of a list of 27 homeowners, 15 were responsive to phone calls and requests. Out of these 15, three homeowners confirmed that the research team decided not to bait and capture owls on their property. All of the remaining 12 homeowners agreed to an interview, and 1 additional interview was performed with a neighbor of one of the homeowners who was present for the capture of an owl. It is difficult to determine a response rate for this study, as it is impossible to know how many homeowners received and read the interview requests and an additional interview was done with a participant not on the initial list. Informed consent forms were collected from interview participants prior to the interviews and any identifiable data that was mentioned in interviews was removed from interview transcripts.

Interview data was collected for this study using a modified Seidman format (Seidman, 2006). Instead of three separate interviews as Seidman suggests, one comprehensive interview consisting of open-ended questions was performed combining Seidman's organizational framework in one interview (focused life history, the details of the experience and reflection on meaning). The reasoning behind modifying the Seidman approach in this case is that group interviews with family groups were being prioritized. It would be difficult to schedule and conduct multiple 90-minute interviews with family groups where the same members would be available for all sessions around work and school engagements. A single interview which encapsulated the three interview sections outlined by Seidman was a much more accessible option for the families. Families were eager to speak about their experience with the project, and many felt that they had already been reflecting back on the project for the past five years, so it

does not seem that the data gathered would be less rich than that which could have been gathered from a full Seidman interview series. The full list of interview questions can be found in Appendix A. Questions in the focused life history section of the interviews focused on participants' prior experiences with wildlife or any other similar projects that they have been a part of before the barred owl project (i.e. "Do you have other experiences with owls before this project?"). For the details of the experience section, project participants were asked about their experiences during the project, including the both the baiting and capture phases (i.e. " Describe your experience during this project. What stood out or seemed important to you?). The reflection on meaning section asked participants to think deeper about their experience and how it may have changed them (i.e. " Do you feel as though participation in this project made you feel more connected to nature?")

Interviews consisted of both one-on-one and group interviews when available. Oftentimes in this project, entire families were involved and friends and neighbors were sometimes invited to observe the process. Group interviews were prioritized in this study as they have been shown to produce richer data as interviewees can elaborate on the responses of others, building upon each other's recollections (Lambert & Loiselle, 2008). Interviews were performed between December 2023 and March 2024 and ranged in time from 15 to 45 minutes. All interviews were collected using a single device microphone and were transcribed verbatim. Once identifiable data was removed, transcripts were moved to a secure folder until they were able to be analyzed.

Data Analysis

All data analysis for this study was based on a phenomenological research approach. This approach to research posits that an idea of "truth" is inherently subjective and is not fully

understandable from observation alone (Hanford, 1975). Truth is something that exists within the mind and is shaped by one's own individual experiences (Krauss, 2005). Following this idea, common themes are searched for in interview transcripts. If recurrent themes are found in the responses from multiple different interviews, these themes could represent some universal responses to an experience. Since this line of research is focused on individuals' lived experiences, it is the most appropriate approach to our research question.

The goal of the thematic coding of these transcripts is to interpret and assign meanings to the statements made by participants. These particular transcripts are expected to be rich sources of meaning, as participants provide their insights into the project and emotional reactions to their experience interacting with barred owls during the course of this project.

The interview transcripts were analyzed using MaxQDA qualitative analysis software. Participant responses were separated into significant individual statements, and these statements were coded for common themes (Moustakas, 1994). The codes used for interviews consisted of both *a priori* and open codes. *A priori* codes consist of categories determined prior to the beginning of coding that are critical to the investigation of the research questions, including changes in feelings of connection and fostering of pro-environmental intentions (Creswell, 2007). The act of open coding allowed for any common themes found during the coding process that did not fall into the *a priori* categories (Williams & Moser, 2019).

Results

Besides the *a priori* codes regarding changes in feelings of connection and the fostering of pro-environmental intention, two other major themes were developed through the open coding process, made up of several sub-themes. These major themes involved close connections made with the primary wildlife researcher and the building of a "community of conservation."

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Negative comments about participation in the project were uncommon, yet they may still provide useful insight about the experience of participation in this project, so they are described in this section as well. Each of the following sections will explain the basis of the theme and will provide quotes representative of the themes.

Theme 1: Participation causes positive changes in the public's feelings of connection to wildlife or the environment as a whole.

Every interview yielded reports of positive changes in feelings of connections from participants following their involvement in the barred owl project. Connections were found between the public and the owls, as well as nature as a whole. Multiple reasons were cited by interview participants for why connections were changed or made stronger including greater awareness of the owls presence, feelings of wonder or awe, and emotional bonds created by getting to interact so closely with a wild species. These feelings of connection are represented in a number of ways, one of which is simply a direct statement of connection. The following quote is representative of these direct statements of connection:

"Definitely, more connected to the owls. Yes….I guess I just felt like I knew them better."
Another participant described a change in connection that they described as a deepened connection with the target species:

> *"I think I'm probably the same connected, but it's a different connection. I think it was like a new connection to our new place, if you know what I mean. Like, we knew the species around there, but it was a deeper connection with one of them."*

Participants who had the opportunity to hold the owls before release had especially unique experiences as it was the first time that nearly all participants had been that close to an owl up to

that point. These participants experienced powerful emotions of fascination and awe that demonstrate a deepened connection. Some of these responses are represented by this quote:

"I mean, overall, it was just an incredibly educational experience, but also an awe inspiring experience, because I was able to get up close and personal with these owls."

The following quote is from the above interviewees neighbor, reflecting on her experience:

"(Participant's Neighbor) held the owl and she just started to cry. She just had this really emotional reaction to holding this owl like all of a sudden, there's this thing she had been afraid of and look at these beautiful feathers and this amazing creature and it's something about those big eyes and it's just so trusting. You know, I think there was just-it was a very powerful moment."

The same interviewee continued on, describing the awe that they experienced in the presence of the owl, a wild animal that they may not have the opportunity to come into such close contact with without participating in this project, and the deep, long-lasting impact that the interaction had:

"The owl being the one that I got the closest to, it's just amazing to experience their power and their presence knowing that you are just this little, tiny, baby human. They could easily hurt you in a second. It's a thrilling and terrifying, and wonderful, and unforgettable experience."

When asked whether or not they feel more connected to wildlife, some participants confirmed that they had greater feelings of connection by stating that they are more aware of the presence of owls around their homes. These quotes represent this type of response to an interview question asking them whether or not they experienced changes in feelings of connection to the owls:

"Oh absolutely! You know, you just think like the big one, it was here... I guess we've

been sensitized or made aware of owls, also what they do for our community and for the

ecosystem."

Another comment described a friendly sort of familiarity with the owl that they came into

contact with during this project. When asked if their connection to the wildlife in their area had

changed the interviewee stated:

"I mean, yes, 100%. I mean, I think you're just aware now. I mean, I also like nature, so

I. We also feel like those owls were ours, you know? Like, yeah, and so when they landed

in our yard, it was like, oh, they're home. Or well, they're not home; they live three

houses down, but we felt like they were ours, you know? Like our pet just came to visit."

The previous quote is also representative of another common way of stating connection.

Participants often stated that they feel as though the owls are almost like their pets or part of their

family. These perceived relationships are complicated and could possibly have some negative

outcomes, but still represent an emotional bond. These feelings can be represented by these

quotes:

"Honestly, it's almost like I have my own pet if you will, that I don't touch, but that I see

all the time."

Another participant who was interviewed described their connection to "their" owl in a similar

way:

"I'm looking at it and it's like, it was just kind of cool that like they kind of opened our

eyes to be able to hear and see more and like it was just almost like a neighborhood pet."

Even if participants didn't necessarily feel as though the owls were their pets, they still felt some

level of ownership of the owls. These feelings of ownership, along with the statements referring

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to the owls as pets, show that participants feel bonded with these owls and feel some level of responsibility for them. These quotes represent participants who state they have feelings of ownership of the owls:

"I really felt like they were my owls, like, I had this like, sense of ownership."

One participant even made a statement extending this feeling of ownership beyond owls to other species of wildlife in their area:

"I think it was an important experience for me, because I think it helps, you know, foster that sense of ownership over local wildlife."

Comments representing this theme were found in every interview and this theme had the most coded statements out of all of the themes.

Theme 2: The participation in the Barred Owl Project fostered pro-environmental intentions by inspiring action to support owls such as ceasing the use of rodent poison, providing higher quality habitat for owls, and advocating for wildlife.

Many of the interviewees stated that they felt some level of pro-environmental feelings before participating in the project, which is not all that surprising, as they were willing to contact researchers and get involved in the owl research project. Some of the participants had prior experience volunteering their time for outdoor organizations that promote conservation (South Carolina Botanical Garden, Foothills Trail, Carolina Raptor Center etc.) or for citizen science projects (Christmas Bird Count, projects sponsored by the South Carolina Master Naturalist Program). Some participants stated that this project did not foster additional pro-environmental intentions, mostly due to the fact that they were already very mindful of their impacts. The

following quote in response to a question asking if participation in the project made them think more about their impacts:

> "I don't know about that. I mean, I feel like I'm already pretty mindful. And always trying to see animals and pay attention."

Most participants did confirm that the study either made them want to participate in more conservation-minded behaviors, or actually do so. Reasons stated for the foundation of these intentions included the acquisition of new information on the impacts of certain activities from Marion Clément, or greater connection with the owls and other animals they see around their properties. These pro-environmental intentions were demonstrated by three sub-themes, which are "Negative Views of Poison Pest Control", "Habitat Protection/Improvement", and "Wildlife Advocacy." The first of these, Negative Views of Poison Pest Control, is among one of the most common codes identified in the interview transcripts. Participants often stated that Clément informed them of the impact of poisons on multiple species through bioaccumulation (Barron, 1995) for the first time, or gave them additional information on the topic. Among the most notable statements across all interviews involved this sub-theme. One homeowner made this very direct connection between the use of poison pest control and the health of the owl on their property:

> "It's like you're killing snakes, you're killing foxes, you're poisoning everything. So that is one big impact… and especially being that up close and personal with Buddy (Owl's Name). It's like you now know who you're poisoning, and it's Buddy. So yeah, there's that connection."

This concern about using poison pest control extended beyond the properties that were used for this project, with one interviewee in particular stating that they would not be using this method of pest control anywhere:

> *"It made me want to change my habits with respect to like, you know, pest control as silly as that sounds, but like, you'll never catch me trying to poison mice in our cabin up in the mountains, because there's this trickle down effect that people I don't think realize when when they make some of those decisions."*

Another participant made the following statement about the use of rat poison:

> *"Marion would say, "Oh, you know, that bird could have been poisoned or..." Whatever the situation, people need to be careful putting out rat poison because owls eat the rats."*

Participants also showed a desire to make their land into better habitats, or preserve the parts of their properties that are critical for owls or other wildlife following their participation in the research project. This took several forms, including ensuring that several resources necessary for the well-being of owls were present and protected on their propertie, such as old or dead trees that owls use:

> *"You can see the old tree over here that's got some woodpecker holes and stuff in it, and you know Marion encouraged me, you know stuff like that, that's not in danger of falling near the house, unless there's like a reason for me to cut it down to leave it standing. Then you can see the pileated woodpecker that's in there a bunch, and so yeah, it does make you feel a little bit more connected, and makes me, not that I'm in control of it, but in terms of what I cut and what I don't cut… I would like to leave some habitat so that animals like that don't get pushed out and I'd love for them to stay and be a part of, you know, the ecosystem that we have here in Clemson."*

Another component of the habitat that some interviewees were concerned with was food sources. The following statement discusses this, as well as the dead trees previously discussed:

> *"Like the wood pile out there. I made a new woodpile, but (speaker's partner) said don't kill the old woodpile. The chipmunks nest there which makes owl food. Beetles are there that can't grow anywhere else. Owls will eat those too! They'll eat crawfish. They'll eat anything. I bought the property in '97 or '98, and they made me swear on the bible that I wouldn't cut down a dead tree. Leave the snags for the birds."*

Another participant expressed sadness at the loss of some tall evergreen trees on their property that they had seen owls use in the past:

> *"You know, not much I can say. I just hope they come back every year. I hated losing those evergreens that they stayed in, but, you know, it's a disease, and I saved some of them, but there's still a lot of trees around here."*

The desire to preserve trees on their property was a very common trend among interviewees. The following quote is an especially dedicated response that demonstrates the foundation of a long-term conservation ethic:

> *"We're toying with putting an easement on this property to keep from cutting it down, so if we sell it still stays. We need islands at least."*

The third sub-theme representing the strengthening of pro-environmental ideals in project participants is that of Advocacy. Participation in this project and interaction with the owls made several participants feel as though they needed to act as a voice for the owls in their community. Comments representing this sub-theme included a desire to tell others what they know about the owls and how they can reduce their environmental impact on them:

"Now that you've got two owls that live in your backyard that aren't just like random

owls that come back, these are like your two owls. So, it makes it different—not that it

should be—but it's not like this random bird just landed in our yard, flew off, and then a

different one comes next time. Right? It's like, you start thinking, like, make sure nobody

puts rat poison out... Like, you're just kind of advocating a little bit more, if you like."

Another participant described a desire to stand up for the owls that bordered on a sort of religious zeal:

" I would be more likely to want to step forward and protect the owl. When you

experience that I feel like it goes beyond you and your experience and it almost makes

you want to be evangelical about the owls."

Another interviewee felt that they were a representative for the owls:

"So, I did feel like, almost like an ambassador. I gotta see what to do about this."

Involvement in this project seemed to create knowledgeable members of the public who would

share their knowledge with others, which could lead to even wider desires to advocate for the

owls:

"I will say, like, I wasn't an expert in anything. I just had a yard that Marian needed. But

then, you become like the owl expert."

The root of most of the pro-environmental actions that project participants advocated for was

new information they learned from the researcher that they interacted directly with. Which leads

to the next major theme.

Theme 3: A meaningful, lasting connection to a wildlife researcher that includes trust in the scientist, and appreciation of their care and knowledge was formed by participation in the project.

The members of the public who interacted with Clément over the course of the barred owl project seemed to build bonds with the researcher almost as often as they did with the owls. The interview transcripts show multiple examples of participants telling anecdotes about Marion, complimenting her, and appreciating her ability to get people involved in the project. Anecdotes about Marion mostly consisted of her actions during the baiting and capture of owls:

> *"It took two attempts to get him with that trap and when they did finally, when he did finally hit the ground, Marion was there when he hit the ground. She just flew out the door of our screen porch. I'll show you. She was here…When we first set up the baiting we would sit in chairs over on that end of the yard and he would come in from one of those two large trees and then when we finally got him Marian was up here in the dark and she just, it's like we didn't have those stairs at the time we had these really rickety, like really dangerous stairs. It didn't matter. She shot right there on top of it and picked him up really quickly and brought him up."*

Anecdotes also showed an additional level of connection, describing interactions with her well after their time participating in the project,

> *"So, (neighbor's name) got a video of an owl once. We had Marion's phone number. Then it was like, (neighbor's name) would send me a video like "hey, there's this owl doing this weird thing on my porch. What's going on? This isn't Winston or Wilma (owls' names). Who is this?" So then you send the video to Marion, and then Marion is like "Oh*

yeah, that's a baby owl. That owl doesn't know how to fly. It's trying to get its balance

and stuff.""

One participant even gave Clément the nickname "Owl", and it existed that way in their phone

contact list all the way up to the time of the interview. This is a part of that participant's anecdote

about when they saw a juvenile barred owl, not yet at the age that it could fly, on the ground

beneath a tree:

> *"Well, yeah, but anyway, I called, I called Owl (Clément), she said, "boy, I'm out of*
>
> *town, but I'll tell you what to do, get, get it to an evergreen, you know, about halfway up*
>
> *that driveway, and it'll climb up," and she'll (the owl mother) sit over here and watch*
>
> *everything we did"*

Participants also told stories about their interactions with Marion that demonstrated that they

appreciated her responsiveness to their questions and concerns:

> *"I'd see Marion driving around with her radio tracker. And I'd be like, have you found*
>
> *him (an owl)? Because for a while, he came back to the yard, like every night he would*
>
> *fly, like over the trees and land, looking for his mice. I mean, it was such good food… But*
>
> *then there would be days, we wouldn't see him and we would get so worried and I would*
>
> *call Marion and say "have you found him? I'm worried about him."...She would be like,*
>
> *"he's much harder to find. He uses a wider range. So there's nights where I just can't find*
>
> *him." Then she just started sending me updates like just found Benny (owl's name)*
>
> *tonight. He's great."*

Participants also frequently paid Marion compliments regarding her hard work on the project or

willingness to share her knowledge with them:

"I just think Marion was also really good with her interns. She made sure that they were very precise. It was very clear that Marion had standards for this project and that she was the driving force behind it."

Interviewees also indicated that appreciated the manner in which she interacted with the owls, as demonstrated by the following quote:

"She's so gentle and like, she really respects the animals, and just to see them- She's sitting there holding this wild owl right here."

Another interviewee described Clément as "thoughtful" due to her habit of letting them know when researchers would be coming by and asking permission each time:

"I kept telling them, "Look, you don't have to call and get my permission. You can come and go out here anytime you want to," but they would always call and say, "Is it alright?" and I would always say, "Sure, but you know, if you want to come anytime, you don't have to ask." But they always were thoughtful."

Several of those who participated in the project also believed that Marion did an exemplary job of getting the public more interested and involved with the project. Statements frequently centered around the deliberate way that Marion designed the project:

"I mean we realized that Marion was very very actively cultivating it… She made it certain that people had opportunities to connect with other people in the project. I know they had the Facebook group."

Another interviewee provided the following quote which describes a sense of "community buy-in" that Clément fostered:

"I mean, I think fostering that sense of connection and ownership is really, really important, I think no conservation initiative, or strategy can really work without

community buy-in and, again, that sense of ownership and so I think what Marion did by

allowing people, just regular people to participate in our research, I think is such a huge

positive.

A different participant also describes this "buy-in":

"The control that she had over this and sort of the campaign that she made. How she sort

of imagined it holistically. She really drove it that way and like I said, the marketing of it

and the building of buying in from the community."

One interviewee described the way that Clément deliberately attempted to get the public invested

in the project as "marketing":

"She was really good about the marketing of it. I mean, she knew that people's

attachment to the project was gonna be crucial to her seeing it all the way through, or

them sticking with it all the way through. So she did a lot of that, you know, sort of

drumming this up as a community of people involved in this project."

The sense of community, such as the one described in the previous quote, that participants felt

was fostered in this project was another major theme that was identified during the open coding

process.

**Theme 4: A "community of conservation" was created which extended beyond the
participants and into the community through the use of social media and the spreading of
information about the project by participants.**

Participants frequently described a sense of community that they felt was created by this

project. The project launched a popular Facebook page for participants that is now followed by

over 500 people, most of which were not even participants in the research process, but have learned about the project from others:

> *"Because I know that like, when I was a part of that Facebook group, everyone was passionate about their own owls and like, especially if, you know, they could see the nest and see the babies."*

Besides just those whose properties were used for owl baiting and capture, friends, neighbors, and work acquaintances were invited to watch the process. This was encouraged by Marion and it built up a community with an interest with conservation particularly surrounding owls and owl habitat:

> *"I would be lying if I guessed how many people were here, but I know (neighbor) came, and then (neighbor), the neighbor.. I'm a physical therapist, so she knows two of my patients, and then she made sure they came, and the whole thing was so cool. I work at (business name), so they all followed the owl project. So, as I treated patients, they kept up with what was going on, and we've even gone and talked to, you know, a group of them, and they wanted me to share again about that."*

One participant, who was also a parent, described how word spread about the project through the community, even through their child's school:

> *"This (the project) sort of got a life of its own, like kids were talking about it in school and parents knew people who had done it."*

Finally, one participant gave the following brief, yet meaningful quote which describes the concept of a "community of conservation" in a simple way:

> *"I really feel like wildlife can connect so many different types of people."*

To those who participated in the Clemson Barred Owl Project, the community of conservation was very real. Participants gathered around the data collection with their families and neighbors, then they told their friends, classmates, and customers about their experience. They shared their feelings of connection and shared the knowledge that they gained from their participation.

Negative Comments Regarding the Project

Negative statements regarding the project were not common, but they are important to consider in order to understand participants' perceptions of the project. One of these statements was related to the fact that many participants had their photos taken holding the owls. A participant stated that this may have come off as exploitative, although they believed that they understood the purpose behind it:

> *"It did feel a little exploitative, but I understand she kinda needed to make it a little bit exploitative just to hook people in and to get people in. Unfortunately that's what we've come to. Because we just can't get people into protecting the natural world without getting them exposed to it and getting them excited about it. We had to hold them a bit longer than was absolutely necessary to get the pictures. The pictures are what felt kinda weird, but again, if you don't document and put it on facebook and talk about it and get people excited then they're just going to keep putting rat poison out and killing the owls. So you have to do it, but it just felt a little weird."*

A few of those interviewed also gave statements that implied that they felt sorry for the live mice that were used in order to lure in owls. The "mousing" technique is an established method of luring in owls (Bierregaard & Harrold, 2008) and participants seemed to understand that, but still acknowledged a sense of sympathy for the mice:

"The general process was that they would set up the feeding station with poor little white

mice and the first few times you just let the owl take whatever he wanted."

Another participant described how feeding live mice to the wild owls could be viewed by the

general public not involved in the project as cruel:

"I would get them to go out and watch the, you know, feeding the owls and whatever they

were, mice… I think the general public would be like, "That's so mean! What are you

doing?""

One other interesting concern that was stated was that someone with malicious intent could learn

the techniques used to lure in the owls for their own purposes. This is a realistic concern, given

the fact that the project seemed to make some participants think of the owl as a pet already:

"Then also realizing how easy it was to train them just to come in. I don't necessarily

know if that's a good thing or bad. I mean, I think the wrong people could be like, I'm

going to train an owl and catch one. And of course, it's completely illegal to do that."

It is important to note that none of the owls captured during this project were injured as part of

the data collection and tracking. The owls were handled carefully by trained researchers or under

the direct supervision of these researchers. The attached trackers/transmitters were attached with

a material which would naturally deteriorate, causing the objects to fall off of the owls after

approximately one month.

These analytic themes and additional comments from the semi-structured interviews with

project participants indicate some complicated, but primarily positive effects that participation in

this research project has on members of the public who may not otherwise have the opportunity

to come face to face with a wild owl. Understanding these reactions to inclusion in the process of

wildlife research will be a step in the right direction, possibly allowing others to learn from the way this project was set up in the future.

Discussion and Conclusions

As far as the two *a priori* themes relating to changes of feelings of connection and the fostering of pro-environmental ideals are concerned, the results of this study line up well with the foundational literature. The increased awareness of owls, along with the close personal interactions that participants were able to have with them because of this project were enough to spark new feelings of connection and strengthen ones that may have already existed from previous, less interactive experiences with owls. Learning more about an animal has been proven to increase positive emotions related to that species (Loyau & Schmeller, 2017) and people tend to remember deep emotional experiences, specifically those involving animals, for long periods of time which means that the connections that were formed could be long-lasting, if not lifelong (Buckley, 2022). The one issue that arises from the types of connection stated by participants in this study is related to the participants who came to view the owls almost as if they are pets. While some made it clear that they know that, even though they feel a pet-owner like connection with the owls, these are wild animals they should not interact with in a normal setting, others did not include this fact. Thinking of wildlife as pets does indicate a level of connection that could indicate that members of the public may have an increased desire to protect these species however, this could be a slippery slope as viewing or keeping wildlife as pets has been shown to have negative effects (Vail, 2018)

The pro-environmental ideals and behaviors described by participants match up with the findings regarding connection. People are more likely to care about and want to protect the things that they are familiar with (Faires, 2006), and having a connection with this species seems

to have led participants to have a desire to make sure that these species, as well as the species that they rely upon, can continue to exist and thrive in their area. Many of those interviewed seemed to absorb and value the information given to them by Clément, and desired to put their new knowledge into action by improving the habitats for wildlife on their property.

One unexpected finding regarding the theme of pro-environmental ideals is the sub-theme of advocacy, which came up multiple times over the course of the interviews. The creation of new wildlife advocates could be one of the most important benefits of incorporating the public into wildlife research if it can be done reliably. Certain citizen science projects have been found to do this to some degree (Johnson *et al.*, 2014), but the ability to connect people with wildlife species that may be difficult for them to normally see or have up close interactions with could create advocates for species that may not normally be reached by citizen science alone. The difference in the case of this study is that the public were able to safely have an experience with a species that is more difficult to get close to and has the potential to cause bodily harm because these interactions were being facilitated by an expert. The connections formed by this type of experience may be even stronger than those formed by the mere observation of species that occurs in most citizen science projects, or even interactions that the public may have with animals during interpretive programs at certain institutions such as zoos however, this cannot be firmly stated without further research into the type of connection made. People do have different perceptions and emotions related to wild versus captive animals, so there is definitely the potential of a novel type of connection that can be created by involving the public in the wildlife research process (De la Fuente *et al.*, 2017).

The other two positive major themes are very closely related. Participants' connections to and appreciation of the main researcher on this project, Marion Clément, seem to be largely due

in part to her particularly strong ability to build participant buy-in and sense of community. Every participant spoke highly of Marion and talked about how she connected them with owls and told them new information about owls that made them see owls in a new light. This construction of a "community of conservation" may be one of the most important part of this project for others to note, as it allows for the promotion of connection of owls and building of pro-environmental intentions to continue on even after the projects is over as the project participants begin to educate others in their lives. The fact that this project was focused on a relatively small area meant that information about the project could be easily spread throughout the local community. Community-based conservation projects have the potential to extend conservation benefits to species besides just the target species as actions taken to assist one species can have cascading effects that help others (Campos-Silva *et al.*, 2021). Projects built around communities also have the potential to have long-term engagement (Campbell & Vainio-Mattila, 2003). Having stakeholders in the community invested in the project increases the chances that the benefits of the project will continue to be felt over a long period of time, although this success can vary based on socioeconomic and cultural factors (Brichieri-Colombi *et al.*, 2018).

Even the minimal negative comments gathered during these interviews have the potential to inform the design of future projects for maximum success. Some components of wildlife research projects may come off as shocking or cruel to the public, especially when it comes to studies regarding predation, as some may have an aversion to the thought of watching one animal eat another (Kellert, 1985). There is also the issue of feelings of exploitation as one interviewee discussed regarding the handling and photography of the captured owls. Despite the fact that the participant who brought up this point recognized why this particular component of the project

took place (to gain public interest and get more people invested in the project),it is easy to see how the multitude of photographs of people holding owls that came out of this study could be seen as exploiting the owls. Many people used these pictures to inform people in their lives about the project, producing a larger number of followers of this study; however, some may be turned away by this perceived exploitation. Exploitation of wildlife for any reason is problematic as it has the potential to lead to increased negative human-wildlife interactions (Willmott et al., 2022). Seeing a wild animal as something to be exploited for attention has had disastrous effects in the past, such as instances where tourists try to get too up close and personal with dangerous wildlife such as bison or bears (Cherry et al., 2018).

The effects of participation in the Clemson Barred Owl Project can be understood by looking at the project through the lens of interpretation. Freeman Tilden's book *Interpreting Our Heritage* (1957) described interpretation as "an educational activity which aims to reveal meanings and relationships through the use of original objects, by firsthand experience, and by illustrative media, rather than simply to communicate factual information." This definition, and the principles of interpretation Tilden described, were based upon his decades of work observing and designing programming for America's National Parks. Tilden outlined these six principles of interpretation:

-**Interpretation that does not somehow relate what is being displayed or described to something within the personality or experience of the visitor will be sterile. Interpretation should be personal to the audience.

-**Information, as such, is not interpretation. Interpretation is revelation based upon information. Successful interpretation must do more than present facts.

-Interpretation is an art, which combines many arts. Any art is to some degree teachable.

-The chief aim of interpretation is not instruction, but provocation. Interpretation should stimulate people into a form of action.

-Interpretation should aim to present a whole rather than a part. Interpretation is conceptual and should explain the relationships between things.

-Interpretation addressed to children should not be a dilution of the presentation to adults, but should follow a fundamentally different approach. Different age groups have different needs and require different interpretive programs.

These principles can be seen in Clément's work with the public during the project. Clément allowed the participants to "meet" the owls that live near them and gave them a lot of new knowledge about the owls and how humans' actions can impact them.This made the owls a more personal issue for them and often provoked them to think more about their impacts and change their behavior in a way that benefitted the owls and their local environment as a whole. By thinking beyond the owls, the participants began to think more about the interconnectedness of humans, owls, and other components of the environment. This was not the initial goal of the project and was not necessarily what Clément set out to do. In a way Clément can be thought of as a "self-taught interpreter" who not only taught the public about owls, but helped them make greater meaning out of their experience which led them to a greater understanding of what it meant to be a good environmental steward.

The Clemson Barred Owl Project clearly had an impact on those members of the public who were involved in it. Every participant reported greater feelings of connection to a local wildlife species and a majority reported increased pro-environmental intentions. Along with these universal benefits, those interviewed also commonly connected closely with a wildlife researcher, learning about their research subject, and felt a sense of community around their

owls. Attitudes regarding the project were overwhelmingly positive. For all these reasons, this project was clearly successful, not just at addressing its research questions regarding barred owls, but at making the public care more about the wildlife that they can see in their own backyard. Since this type of emotional bond with wildlife has been shown to be associated with further environmental action, this project would seem to have created a multitude of people who are environmental activists to some degree in upstate South Carolina. The world is changing quickly and this type of person is needed in order to ensure that the natural world is not forgotten. This study was done in the hope that wildlife researchers can view the Clemson Barred Owl Project as an example of what can happen when the public are invited to be a part of their work. Everyone may not be a wildlife researcher, but there is no reason why everyone cannot be a wildlife advocate.

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CHAPTER 3

MEETING "OWL": A WILDLIFE SCIENTISTS'S APPROACH TO FACILITATING THE PUBLIC'S CONNECTION TO A LOCAL WILDLIFE SPECIES

Abstract

In 2019 a wildlife research project conducted by a Clemson University graduate student on Barred Owls use of urban and semi-urban environments, invited the public to participate due to the need for cooperation with homeowners to help identify frequent owl sightings. Although the invitation for homeowners was not part of the research, the interest in the research and the owls became a phenomenon that persists five years later. A separate research study on the participants in the research project findings suggests that participation in the project caused increased feelings of connection to nature, greater pro-environmental intentions and behaviors, an increased desire to be a wildlife advocate, and an admiration for the project's primary researcher. This case study involves an examination of the approach to research that was inclusionary and lasting for participants. This was achieved by both interviews with participants as well as an in-depth interview with the past graduate student who was the primary researcher on the project with the goal of understanding what aspects of the project and the researcher made the project well-equipped to facilitate connections between the public and wildlife. The results suggest that aspects of the project, such as certain traits of the target species, the type of data collected, the non-invasive methodology, and the community in which it was centered helped make the project successful and made the strengthening of the human-wildlife connection possible. Some actions of the researcher, such as cultivating an approachable atmosphere, sharing their enthusiasm for the science with the public, and providing informative scientific

communication also contributed to the project's success. These results could be used as a foundation for the design of wildlife research projects or future research into the effects of involving the general public in wildlife science.

Introduction

Wildlife science researchers have the potential to make significant discoveries that can add to the body of knowledge and help further current conservation efforts, but there may be untapped benefits that researchers could unlock by inviting the general public into the world of wildlife research. Engaging the public in conservation is more important now than ever as the natural world is increasingly facing threats that stem from human development. This engagement is especially critical for wildlife science as the planet is experiencing a rapid loss in biodiversity, with an average decline of 69% in species populations since 1970 (Dirzo *et al.*, 2022). Helping people understand environmental issues affecting wildlife and building connections between wildlife and the public is vital as the literature shows that those who are more aware of these issues and are more involved in science have been shown to feel more motivated to adjust their own behavior to reduce their impacts and inform others about what they can do to help (Grodzińska-Jurczak & Cent, 2011). Getting local citizens/stakeholders involved in conservation has numerous other benefits as well, such as reducing the intensity of conflicts between wildlife managers and the public (Young *et al*., 2010) and increasing trust in scientists (Munton, 2003), which may increase the likelihood of positive conservation outcomes in the future (Young *et al.*, 2013). Additional benefits include the improved ability of wildlife researchers and managers to incorporate the values and knowledge of the public into management decisions (Renn, 2006) and democratize the conservation process (Webler and Renn, 1995).

This study is focused on how one research project, by inviting the local community to observe and interact with a local wildlife species, in this case barred owls (*Strix varia*), as part of a wildlife research project, created strong emotional connections between the public and the wildlife they see in their own backyards. Connection with wildlife in this case will be defined as

an emotional bond between humans and one or more species based on interaction and familiarity. (Vining, 2003). This connection showcases the potential positive benefits that involving the public in science can have. This research will shine a spotlight on a single project, the Clemson Barred Owl Project, and the scientist who was behind it in order to better understand how the project went beyond simply studying barred owls, by bringing people closer to wildlife and building a community based around conservation.

Marion Clément was the lead researcher behind the project being investigated by this study. Clément had a history of working in wildlife research before the Clemson Barred Owl Project. Before ending up at Clemson University, Clément took part in a fellowship with Maryland Department of research and worked as a wildlife habitat restoration biologist. During these experiences she was exposed to many different conservation professionals in fields as diverse as fisheries, habitat restoration, social science, and environmental education. Following these experiences, Clément was chosen to act as the executive director of the newly created Maryland Bird Conservation Partnership and spearheading the development of the organization and facilitating partnerships between organizations that would go on to collaborate on conservation work in the state of Maryland. Still feeling drawn to field work, she left the executive director position and decided to pursue a degree in Wildlife and Fisheries Biology at Clemson University.

In the Spring of 2019, Marion Clément led a team which performed a study that involved calling in, capturing, and attaching GPS transmitters to Barred Owls (*Strix varia*) to investigate key features that facilitate their presence in developed areas. In order to locate more sites to lure in and eventually capture owls, the project added a public involvement component and began reaching out to the local community using multiple methods such as "social media, news

publications, and fliers" (Clément *et al.* 2021). Property owners who believed they may have barred owls on their property were asked to contact the research team. Multiple property owners reached out to the team indicating that they saw or heard owls frequently on their property and those who were willing to participate were visited by Clément. Barred owl vocalizations were played in order to call in an owl in order to verify their presence and if owls were found then the property owners would be informed and the process would be described to them. Those who lived on the property were directed to keep themselves and any pets they may have inside and to be as quiet as possible during the luring in or capturing of the owls. For approximately a week, the research team spent approximately 30 minutes each night training the owls using the "mousing" technique. On the final night when the owl swooped down to attempt to catch a mouse provided by the researchers the owl was netted. Captured owls went through a full work-up involving data collection, which included the collection of blood samples, the taking of various measurements, and feather aging, as well as the attachment of a battery-powered GPS transmitter.

On the night of the capture, those who lived at the property, as well as invited neighbors and friends, could quietly observe the process of data collection, name the owl, and a small number of those present would be allowed to hold the owl under the guidance and direct supervision of Clément. On one occasion Clément even carefully transported a captured owl to an adjacent location and did the process in front of a crowd of summer camp children and other community members. Following the release of the owl, often by one of the members of the public present, Clément would track the owls and map out their home ranges. This project was successful in gathering meaningful data on barred owls, and also, in getting members of the public invested in wildlife research. The Clemson Barred Owl Project was a novel opportunity

for most participants as owls are not typically seen close up. Owls are most active between twilight and morning, they fly silently, and, as most wild animals do, try to avoid contact with humans as much as possible. The overwhelming interest and support from members of the public who interacted with this project was unanticipated.

In another study, members of the public were interviewed in order to gain an understanding of the effects that participating in the project had. This study (Chapter 2 of this dissertation) was a phenomenological study focused on the experiences of the members of the public involved in the Clemson Barred Owl Project, specifically focusing on the connections between people and owls and pro-environmental intentions formed by participation in the project. This data was used to assist in the composition of the interview, giving the interviewer a more informed position from which to write questions which focus on the successful aspects of the project. Comments made by Clément can also be compared to comments made during the interviews. Interviews with participants (see Chapter 2) revealed that, among those interviewed, every person who had a chance to watch the process and interact with an owl formed strong emotional connections with the owls, and this connection caused them to be more mindful about their environmental impacts. It was also revealed that participants formed an admiration for the researcher based on their passion for the owls and ability to smoothly run the project, and that news and information about the project was spread throughout the community by participants.

The effects of this project seemed to not only have a strong positive effect on those involved, but the rest of the community as well as word about the project spread throughout the community. Despite less than 20 properties being utilized for the luring and capture of owls, the "Clemson Owls" Facebook page, which was created and managed by the main researcher of the owl project for the purpose of communicating with the public about the project, has accumulated

over 500 followers. With this level of diffusion into the community and the strong following of the project it seems that this project led to some significant positive side effects for the community and the local area. This success warrants further investigation.

This study was conceived to further understand the lasting impacts of the Clemson Barred Owl Project. The purpose of this study was to try to better understand what aspects of this project made it especially successful at facilitating connections between the public and local wildlife. Specifically, we seek to answer the following research questions:

RQ1: What components of the Clemson Barred Owl Project made the project particularly well-equipped to facilitate meaningful human-wildlife connections?

RQ2: What traits of the primary researcher of the Clemson Barred Owl Project made the researcher particularly well-equipped to facilitate meaningful human-wildlife connections?

Methods

Approach to Research

For understanding an exemplary individual or atypical situation, Creswell (2013) recommends using narrative analysis, phenomenology, or case study. For the purposes of this study, looking at the Clemson Barred Owl Project as an instrumental case study makes the most sense, as instead of looking for generalizable conclusions this study seeks to understand why this project was so successful at building connections between people and wildlife. Phenomenology typically would examine the experience of multiple people in order to find commonalities between all of the people's experiences, which would not work well in this case where the goal is to gain a robust understanding of one particular case. Narrative analysis is also not the best choice as the focus of this study is not to understand the narrative constructed around the project and it's impact. This study seeks to understand what contributed to the success of the Clemson

Barred Owl Project as a single case, so an instrumental case study is most appropriate.An instrumental case study can use the experiences of a single exemplary individual in order to support the understanding of another larger topic (Stake, 2005), which in this case is how to design a wildlife research project that facilitates positive human-wildlife connection.

This qualitative study will primarily utilize a semi-structured interview made up of open-ended questions (the interview script can be found in Appendix B) in order to discover exactly what aspects of the project or researcher led to this project's success. Single sample case studies can serve multiple purposes besides just enhancing researcher's understanding of one notable case, including providing new insights that could be built upon by future research, increasing awareness of that particular case, and familiarizing the researcher with the subject, which can inform how they create new theories or frameworks (Yin, 2014).

Qualitative studies of one are built upon the principle that qualitative research at any scale helps researchers to understand complex or nuanced situations on a deeper level (Austin & Sutton, 2014). The idea of performing a qualitative study with a sample size of one is not a new one. The fields of psychology and medicine may be the most well known sources of case studies. In these fields case studies of novel situations are used to turn unusual circumstances into learning tools that professionals can refer to in order to inform the ways that they address similar issues that they may encounter (Donmoyer, 2009). A case study involving a single individual is a useful method for understanding the experiences and methods of exemplary individuals who have achieved particular success in their field or who encountered, and had to overcome, a unique situation. For example, this sort of study design has been used a number of times in education research, helping researchers to understand how educators have adapted to new teaching methods or technologies (Sullivan *et al.*, 2017), or to understand the experiences of

students who overcame adversity and achieved success (Gillen & Bhattacharya, 2013). Others whose experiences have been recorded by this single sample methodology include other exemplars, such as counselors with notable positive responses to extremely challenging situations (Daniels *et al.*, 2007) and coaches who empower their athletes and have especially successful, winning records (Jones *et al.*, 2003).

One of the most common criticisms of case studies focused on one individual is that the data extracted from one person's experience cannot be generalizable (Yin, 2009). Besides the fact that any one person's voice or experience should be valued and considered simply because it is important to let people have their voices heard, behavioral science suggests that human behavior is, to some degree, predictable (Zhang *et al.*, 2021). If one person has an idea or experiences something a certain way there is a chance that the situation will happen again and others will have similar reactions.

Description of Data Sources

Primary Researcher Interview

This study primarily gathered data using a single interview with the primary researcher who organized and carried out the Clemson Barred Owl Project, Marion Clément. Because the purpose of this study is to understand why this one specific research project formed strong connections between the public and wildlife, this study primarily uses data from the interview with Clément.

The interview was semi-structured in nature and followed a simplified version of the Seidman interview methodology (Seidman, 2006). A modified version of the Seidman interview series, which combined the three interview sections outlined by Seidman into a single 90 minute interview, was chosen in this case to accommodate the researcher's busy schedule. Clément is

currently conducting wildlife research for another organization and a single interview was a much more accessible option in this case.

The three sections were made up of "Focused Life History, "Details of the Experience", and "Reflection on the Meaning" . The focused life history section contained questions pertaining to the researcher's personal and professional history related to wildlife and wildlife research (i.e. "What first got you involved in wildlife research?"). The details of the experience section focused on the Clemson Barred Owl Project itself. Questions mostly focused on obtaining a description of the project from planning to owl release directly from the project's primary researcher. (i.e. "Could you describe the typical process from contacting the property owner to owl release?"). The reflection section focused on discovering what about this project made it especially proficient at forming emotional connections between the public and wildlife (i.e. "What aspects of this project do you believe made the public involvement aspect especially useful").

The interview was conducted virtually using Zoom and was transcribed in real time using the Otter.AI transcription service. The transcript was verified by the researcher by listening to the interview recording.

Project Participant Interviews

Interviews with participants of the Clemson Barred Owl Project were crucial to this study. Overall 27 property owners were contacted by this study's primary researcher. Out of those, 15 property owners responded, with 3 respondents indicating that an owl was not lured in on their property. The other 12 respondents were willing to participate in an interview and one additional participant was interviewed who was present at a neighbor's house for the capture of an owl, making the total number of interviews total thirteen. These interviews were done with

groups of participants when possible, but solo interviews were also performed. Interviews were conducted with 1-4 project participants. Oftentimes in this project, entire families were involved and friends and neighbors were sometimes invited to observe the process. Group interviews were prioritized in this study as they have been shown to produce richer data as interviewees can elaborate on the responses of others, building upon each other's recollections (Lambert & Loiselle, 2008). Interviews were performed between December 2023 and March 2024 and ranged in time from 20 to 45 minutes. Any identifiable data that was mentioned in interviews was removed from interview transcripts.

Interview data was collected for this study using the same modified Seidman format as the researcher interview. Instead of the three separate interviews as Seidman suggests, one comprehensive interview was performed combining Seidman's organizational framework in one interview (focused life history, the details of the experience and reflection on meaning). The full list of interview questions can be found in Appendix A. Questions in the focused life history section of the interviews focused on participants' prior experiences with wildlife or any other similar projects that they have been a part of before the barred owl project (i.e. "Do you have other experiences with owls before this project?"). For the details of the experience section, project participants were asked about their experiences during the project, including the both the baiting and capture phases (i.e. " Describe your experience during this project. What stood out or seemed important to you?). The reflection on meaning section asked participants to think deeper about their experience and how it may have changed them (i.e. " Do you feel as though participation in this project made you feel more connected to nature?")

All interviews were collected using a single device microphone and were transcribed verbatim. Once any identifiable data was removed, transcripts were moved to a secure folder

until they were able to be analyzed. This analysis uncovered several themes that were representative of the universal outcomes that participants in the project experienced including increased connection to a local wildlife species, increased pro-environmental intentions and behaviors, a greater desire to advocate for wildlife, an admiration of the primary researcher, and the fostering of a community based around conservation.

Data Analysis

Data analysis of the interview with Clément, as well as the interviews with project participants, involved the reading and coding of the interview transcripts. The idea behind the thematic coding of the transcripts and surveys is based upon the approach that "truth" exists within an individual's mind, stemming from their experiences instead of just being observable from their experiences alone (Hanford, 1975). The interview with Marion Clément seeks to extract some of that truth. If common themes can be found in the thoughts and feelings of several participants, these may be considered some of the universal traits of a particular experience.

For this study, the transcript from the interview with Clément was analyzed using MaxQDA qualitative data analysis software. The interview transcripts and survey responses from this study were broken down into single statements and these statements were coded thematically (Moustakas, 1994). Inductive coding was used for this study. The act of inductive coding allowed for the themes present in the transcript to be developed from the data as opposed to deductive coding in which codes are determined prior to analysis(Williams & Moser, 2019).

Results

Overall, seven themes were identified from the interview with Clément and these can be categorized into two groups. These two groups are aspects of the project that facilitated human-animal connection (Aspects of the Project), which contains four major themes including those

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related to specific characteristic of the target species, the non-invasive nature of the research, the use of location data, and the support of the community in which the project took place, and traits of a researcher that makes them well-equipped to connect people and wildlife (Traits of the Researcher), which contains the remaining three themes. These themes relate to the approachability of the researcher, the researcher's passion for the science, and their scientific communication skills.

Aspects of the Project

The interview with Marion Clément revealed four themes which relate to the project, which were suggested to contribute to this project's ability to form connections with wildlife among the participants. These are aspects of the project which were either directly identified by Clément as important to the project's success or aspects which could be identified from comments that Clément provided about project participants' connection with wildlife.

Theme 1: Certain characteristics of the target species of the study seemed to make it easier for participants to form strong emotional bonds.

Part of the reason that this project may have been so successful may have to do with certain traits that the barred owls have that make them easier for people to connect with. Over the course of the interview, Clément noted several traits that the owls had that may have made it easier for people to associate with the owls. One of these traits is that barred owls are relatively calm animals when captured, which makes them easier to work with and made it possible for participants to help hold and release the owls. Clément describes barred owls as having a "calm demeanor" when handled and she made the following comment about the handleability of the owls:

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"You can handle them without too much fright or struggling and that really helps. It feels

like a much better introduction into wildlife handling, because it would be hard for

people emotionally if the owl was struggling"

The following quote also demonstrates how the owls calm demeanor made it easier for people to

interact with them:

"Mammals, for example, if they're terrified when you're handling them, they'll look away

because that's their communication of "please don't hurt me"- , but owls…have a way of

just looking at the person while you're handling them. They will swivel their head and

I've literally held an owl in front of a group and it just took turns looking at every single

person that was around them, making direct eye contact."

The fact that the owls were relatively unbothered while being handled afforded the opportunity

for researchers to pass the owls off to participants so that they could experience holding a wild

owl for themselves. This was only done when conditions were right and the owls did not seem

stressed. At many of the properties one or two participants were able to hold the owl and then

release it. This quote from Clément describes the experience of holding an owl and the responses

that she saw from participants:

" It's one thing to be able to see them up close, but holding it is a different story. Feeling

how heavy it is, how warm it is, how soft it is. This is something that changed my life.

When my mentors put an owl in my hand, that was the moment that I will always

remember. I was holding a little alien that lives right here on this planet, and it is a

beautiful creature looking back into my eyes. That emotional connection is worth so

much… If an owl was really calm, then it takes nothing to just take two seconds to hand it

off to someone to let them be able to hold a wild animal like that. They were very short

little moments where we instructed people how to be safe, how to keep that animal safe,

but they were really important for the emotional connection. Unless the owl seemed

stressed out we always tried to identify one or one or two individuals that could just hold

the owl and then release it."

Another factor which seemed to make it easier for people to connect with the owls is one that is

well documented in the literature, and that is that owls are charismatic animals. Charismatic

animals are animals that can be described as " rare, endangered, beautiful, cute, impressive, or

dangerous" (Albert *et al.*, 2018) and it has been demonstrated that charismatic creatures get more

attention from the public (Dobson *et al.*, 2022) which can lead to positive outcomes such as

higher funding for conservation projects related to the species (Hosey *et al.*, 2020). The

following quote is one of several in which Clément describes how the charismatic nature of the

owls captured participants' attention:

"It was really exciting to see how charismatic these owls are, how deeply the love that

people have for them is, and how much they could really change people's perspectives.

We started off working with a lot of people that were really, really timid and were scared

of them or really disengaged and then towards the end, they were absolutely in."

It was also suggested that the owl's appearance added to this charisma. The owls were often

described as "cute." Clément believed that this trait is one that could carry over to other projects

and this is supported by the literature, as "cute" animals are more likely to garner public support

(Wallace, 2021). The following quote is representative of this concept:

"I think any project where the animal is cute works the best. I think people connect a lot

more to birds and mammals than reptiles and amphibians."

The size of the owls was another trait that Clément believes made the owls seem more relatable. This comment reflects this sentiment:

> *"I think their size probably makes them easier to relate to. They are just little beings that we can relate to."*

Their size also makes them more visible in the wild which also allows for opportunities for people to see and develop connections with them:

> *"They're about the size of a cat or dog and they are also highly visible."*

Another trait mentioned by Clément was that the owls are relatively long-lived as compared to other animals. Barred owls could live 15 to 20 years and this means that people may be observing the same owls regularly for years to come:

> *"They're long lived and so I think being able to have an animal that's on a similar timeframe as humans, obviously very different timeframe, but we can observe it and it's not a different animal every year. It's the same one and you can start observing its habits and we're creatures of habit, right? We like our coffee in the morning. We walk over there in the middle of the day and the owls are doing the same thing. I think we see ourselves in the owls and that really helps people to feel connected to them."*

The ability to relate to owls and connect their behaviors to human behaviors as mentioned above was another of the traits that seemed to help people connect with owls. Owls are attentive parents and this is one of these traits that people picked up on:

> *"They're nesting and humans love babies. They're little nestlings that look like giant puffs of cotton with two little, round, beady eyes. They're also very charming and being able to observe two parents co-parenting and raising their nestlings is something that's very endearing."*

Clément made the conscious decision to take advantage of this familiarity people can have with owls identifying them as individuals by their behaviors:

"I wasn't afraid to talk about the individualism of the owls. They have very different personalities, so when you're spending so much time baiting an owl day after day, you get to see some pretty cool stories that are just lovely to share with people. It reinforces the emotional connection we have with them as humans. They have little dramas that happen in their lives as well. Little personality traits."

Identifying wild animals as individuals and assigning them human-like traits is controversial in wildlife research, as some feel that it can have negative effects in the long run as humans personify the owls more and more, misrepresenting the wildness of the animal (Auster *et al*., 2023), but Clément sees the value in helping people to identify the owls as individuals, even going so far as to allow the participants to give each owl a name so that they can identify them and feel closer to them. She explains her reasoning in the following quote:

"It's a little bit taboo to name individuals you're studying, because they're wild animals and should be kept as wild animals. I hear that a lot. I hear that a lot from people and I understand that rationalism and I think that it has a time and place, but I also think that we live in a world where more and more of us are on the planet and we're constantly bumping elbows with wildlife and wild spaces. I understand the rationalism that research needs to be serious, but you're missing the point if you're unable to connect it back emotionally with the public."

Most of the participants interviewed called their owls by name and referred to them as their neighbors. Personifying the owls to some degree and treating them as individuals seemed to lead

to close personal connections with the owls and this sort of connection has been shown to lead to greater pro-environmental intention (Rosa *et al.*, 2018).

Theme 2: The relatively non-invasive nature of this research meant that the public could easily be present for all aspects of the project.

The fact that the data collection methods and the attachment of the backpack were non-invasive meant that participants could watch the entire process and that the owls could be held for longer. For some species it is impossible to simply attach a GPS transmitter to an animal using a backpack as happened in this project. Putting a transmitter on some species can be a very invasive process:

> *"There's a lot of species where tracking involves implanting a GPS and an operation, or anesthesia. You have to put the animal to sleep."*

This sort of activity may be harder for the public to watch for logistic and emotional reasons:

> *"I think it creates more of a risk for people to misunderstand the greater picture of why we're doing what we're doing. I think it requires a lot more prompting and a lot more preparing for the public who would be involved in these sorts of things. I'm not saying it can't be done, but I think it's much easier when you're just catching an animal, not sedating it, doing a couple things before you release it and the animal can go on."*

Seeing an animal being sedated and having a transmitter implanted under its skin could be stressful to participants and lead to misunderstandings, such as believing that the benefits of the research are not worth the invasiveness of the procedure. Clément gives another example of this and notes that it would be harder to include the public in such a project due to the complicated nature of some of these methodologies:

"But there's lots of marine waterfowl that we can't put a backpack on, because it would change their body shapes too much and it would ruin the waterproof properties of their feathers. When they get a transmitter put in, they get stitched back up. They get held in a cage for 24 hours before they're released and that is totally fine. Ethically, it is fine and the birds are fine, but I think it would be a harder thing to involve the greater public in."

The fact that the Clemson Barred Owl Project's most invasive procedure was the collection of a small blood sample definitely made it easier for the public to be involved in the project. It would be much easier to involve the public in projects that have similar methodologies to this project, than to those which involve more complicated or invasive procedures.

Theme 3: The collection and sharing of location data meant that participants could have a better understanding of where the owls went and what they did, making them feel more familiar and making their local area feel special.

The ability to see where the owls traveled was something that fascinated project participants. Several participants mentioned the maps shared with them by Clément in the participant interviews. In this quote, Clément describes the sharing of this data:

"We strived to share the data with all of our homeowners and so all the people who participated and allowed us on our property would get access to this private map that was updated weekly to see where their owl was hanging out the whole time. That was really exciting for them."

Clément described the GPS data as being very popular among the participants:

"I don't know what it is about humans and GPS units, but we love watching GPS points."

The data allowed for property owners to view a solid visual representation of the ranges of the owls on their property. This easy to understand and visually appealing method allowed people to better understand the owls' behaviors and habitat needs:

> *"Nobody wants to look at an Excel spreadsheet, but a good map that has all of the locations where the owl went so that you can see that it went on your neighbor's swing, and that it hung out on your roof, that it likes to sleep in your conifers. People love it. The type of data that the project was also producing was something that was really attractive."*

The location data from this project was popular among participants and one can see this fascination with the location of a specific individual in other projects. Many projects utilize the GPS tracking of animals of very different species such as sharks (Hawkins & Silver, 2023) and birds (Latham *et al.*, 2015).

Theme 4: Clément believes that the study area utilized for the Clemson Barred Owl Project may have contributed to the success of the project as the public welcomed and supported the research.

The area in which the project took place contains Clemson University, and the area is very supportive of the University. This support may have been part of the reason that some property owners allowed researchers to study the owls on their land, as the project was affiliated with Clemson University. Participants made statements to Clément that essentially said:

> *"I will allow you to come here to do your work because I love Clemson."*

Clément felt his support for students of and projects related to the University, along with the kind nature of the local community that she encountered, may have been a crucial component to the project's success:

> *"I also think about the Clemson community as being pretty integral to that (the project coming together) and so because we're in South Carolina, where people in general are very warm, inviting, and generous, and because we were working in the Clemson community where there's a huge sense of pride, I think that really facilitated our efforts. I was shocked at how easily people opened up their doors to us and just said "yeah, just come over. I don't even need to know if you're here. You don't even need to tell me you're here." I don't think this project could have worked as well as it did in a different setting where maybe the community trust has been eroded. I think that this project has a potential to be replicated in any number of settings, but I do think that those challenges could be greater for public outreach elsewhere."*

The Clemson community even assisted with the funding of the project. Some of the most critical pieces of this project may not have occurred without the direct support of the community:

> *"I was given a budget that didn't allow for the use of GPS transmitters. You can get such useful behavior data from being able to tell where animals are going and when and what they're doing, but we just didn't have the money, Because of that public engagement and because people were connecting emotionally with the project we were able to raise funds from the ground up and make it a much bigger project than we had originally planned."*

The support of the local community seemed to play an important part in the success of this project. In a way, the Clemson Barred Owl Project and the Clemson community had a sort of

symbiotic relationship. The community supported the project and the project connected the community.

Traits of the Researcher

Three themes which relate to the researcher, in this case Marion Clément, which were suggested to contribute to this project's ability to form connections with wildlife among the participants. These are traits possessed by the researcher which were identified via a direct interview question related to the qualities needed by those seeking to facilitate connections between the public and wildlife and other statements made by Clément which represented aspects of her interaction with the public that revealed these traits.

Theme 5: Having a respectful and patient nature can foster trust from project participants and make the researcher more approachable.

When under the pressure of holding a wild owl, it would be beneficial to keep a cool head and the same is true for navigating interactions with the public. Clément describes several traits that she believes are important to making research projects that involve public work, and one of the most foundational of these is the ability to smoothly navigate interactions with the public. Inevitably, when research activities are occurring in view of the public, questions will arise, either from those closely observing the process or from others keeping an eye on the activity from afar. The fact that the luring in and capturing of owls for this project took place in silence in the dark might raise even more questions. Clément describes this scenario in this quote:

> *"Bystanders would come by, and that would be really challenging for me because at this point I have an owl in my hand and I'm trying to be as efficient and as quick as possible.*

so that I can release the owl. People are walking into the project with absolutely no

context and are wanting an explanation…but that is always the trickiest part about doing

public engagement with science is that people can misunderstand what you're doing and

they can get upset, and that can create a lot of issues for the researchers. That's actually

why some people choose not to make their research public, because they just don't want

to deal with that risk."

The ability to be able to keep a level head and continue with the delicate work being done while

others are asking questions would be very beneficial to any wildlife researcher who is thinking

about inviting the public to be a part of their project. Clément suggests that it is important to be

diplomatic and very polite with potential participants in order to make them feel more at ease

working with researchers and, in this case, more at ease with them coming onto their property.

She stresses the importance of this in the following quote. She states that good facilitator of

positive interactions between the public and wildlife needs to:

"*be extremely respectful and polite so that people can build trust in that person, and*

never discount a question as being stupid, because people come from all different

backgrounds and any question is a potential for that person to stay connected in the

project. It needs to be someone who's really reassuring and inviting"

Since people come from many different backgrounds, the ability to communicate with diverse

groups of people is an especially helpful skill when conversing with the public. Clément stated

that someone who wants to successfully bring the public into their research projects should be:

"someone who is easy to talk to, and who can handle a variety of different personalities."

Communication is key to navigating interactions with the public without causing a misunderstanding or accidentally turning someone off from participating in the project. The following theme, similarly to this one, deals with a researcher's communication skills.

Theme 6: A researcher who is a good science communicator that can translate science into easier to understand language and concepts can make science seem less intimidating to participants, making participation feel more accessible.

Clément highlights the importance of being a proficient science communicator, not only to be able to effectively communicate with members of the public who you would like to be a part of your research project, but also to increase hireability in the field of wildlife biology:

> *"Willing and able to communicate hard science into a common language that people relate to and understand. I think that's a quality that is more and more important in scientists today and something that hiring managers look for is your communication style with the public."*

Science communication is how new scientific discoveries and solutions to problems are made more accessible to the public. The ability to efficiently communicate the goals, results, and outcomes of research is something that academic programs in the sciences are beginning to stress the importance of (Brownell *et al*, 2013). In the case of the Clemson Barred Owl Research Project, participants often professed Clément's ability to easily communicate about her research and stated how much knowledge they gained from their interactions with her, with many of the participants even adjusting some of their behaviors to be more environmentally friendly after getting new information from Clément. Project participants still keep in touch and ask her questions about their owls five years after the conclusion of the project:

"I get a lot of people sending me photos, telling me that their owls are still around and that they're just so happy to see them…Our website is still up actually. I've been meaning to disable it, but I still get entries from people who hear about the project, but maybe don't know that it's over and they want to be involved. There is a Facebook group where people still regularly contribute updates about their owls."

Clément clearly has kept her lines of communication open. She receives occasional updates on the owls and has continued to provide knowledge with those who participated in the project. Many participants who still keep in touch with her have made comments expressing the importance of the project and how Marion's knowledge and direction have had an impact on their lives:

"I think it at least created some memories that they will treasure for a long time and I still hear from a lot of them. I get updates pretty frequently and a lot of them tell me that the project was really instrumental in their lives in terms of forging a passion for the outdoors and wildlife. I think that's the biggest stakeholder group. A lot of people also just enjoyed hearing about the project, even if they might not have been involved in it."

One especially interesting event that occurred in the project relates to Clément's ability to effectively communicate about her research. Clément was invited to speak at a summer camp and, after being impressed with the children's knowledge of owls, she invited them and their parents to come and observe her working with an owl:

"I would get invited to speak at clubs and events and one of the lectures that I did was for young kids that were part of a summer camp at the Botanical Gardens that was focused on the environment. I was so impressed with those kids. I had a slideshow with all these different owl faces and they all knew what the owls were before I even told them. I was

amazed and they were so excited about the owl presentation that at the end I couldn't

resist and I said "Hey, we're trapping an owl on Saturday. It's going to be in this area.

I'll send the information along and if you can go there with your parents, great!" There

were maybe 20 kids there and their parents."

Clément was astonished by the turnout, but was able to do the work that she needed to do with

the owl, while also communicating with and trying to manage the children:

"That was a big shock for me. I'd never had this many people at an event like this and it

spooked me. I said "This is way more people than I would typically allow for something

like this, so I'm really going to need your help." I said "kids, you need to keep your

parents in line because I know they're gonna want to run around and scream", but the

kids were wonderful. The only thing was that I had them all kneel around me and I had a

little circle of kids around me while I was working on the owl. The only thing was that

they kept scooting towards the owl very slowly."

The ability to communicate effectively with people at many different age and knowledge levels

demonstrates a talent for science communication that Clément possesses. This ability no doubt

factored into the success that this project had with getting the public invested in their local

wildlife.

Theme 7: A wildlife researcher can foster a community of environmentally well-informed

people who can become enthusiastic about and involved in conservation by engaging with

the public and sharing their passion for their discipline.

If only one statement could be made from the interview transcript from this study it

would be that Marion Clément has a passion for wildlife. She describes her work as "her life's

calling" and she clearly stated during the interview how happy she is to share this passion with others, such as the participants in the Clemson Barred Owl Project. She went so far as to imply that when she sees the public really engaging with her work that it reaffirms her excitement for science:

"Being able to communicate about it and geek out with the public even though you've seen it a million times. For me this project was a huge gift, because you hold so many owls in your hand and as amazing as it is, sometimes you just forget how amazing it is because you've done it so many times. When you surround yourself with people who are so excited about it, then it reminds you why you're doing what you're doing and how cool it is."

This response is especially interesting because at the beginning of the project, the public involvement aspect was not one of her primary concerns, but she came to enjoy this aspect of the research:

" This grew naturally from "I have to do it to get this work done" to being "I love doing this and the more people that are there the better."

The act of engaging with the public and sharing her passion for wildlife became especially rewarding for her once she began to see how her enthusiasm for conservation began to rub off on the participants:

"So for me, that was incredibly rewarding, just seeing the light spark in people's eyes. I found it especially rewarding when people started off being disconnected from the project, just basically allowing us on their property, but then having a big change of heart and coming around to the point where they were absolutely enamored by it. I think for me, the cherry on top was when people made the connection that they could have an

impact on how the owls are doing. They were asking me about rodenticide, asking me about landscaping, asking me about all of these things where they are willing to make a behavioral change. It was important to them to make a behavioral change for these animals to persist in the wild, and for me that's the best that you can hope for as a conservationist is for people to see the light and go that way."

The ability to share information with the public is one thing, but the ability to share an enthusiasm for conservation with the public is another thing entirely. The ability to motivate people to make a behavioral change for the good of the environment is at the core of all conservation movements. If other projects had researchers who were able to engage with participants and instill a passion in the conservation of wildlife to the degree that this occurred in the Clemson Barred Owl Project, then there would be a lot more wildlife advocates in the world.

Discussion and Conclusion

Putting focus on an exemplary project and researcher in wildlife research is instructive, as it can provide guidance for planning projects which promote meaningful connections. Those involved with the Clemson Barred Owl Project are still eager to talk about the project and the owls on their property. The direction in which Clément took the project clearly forged strong connections with a local wildlife species and molded the group into more environmentally conscious citizens. Understanding the implications of the aspects of the project and the researcher behind it that made this such an impactful experience for participants, as well as how these traits are represented in the literature, can provide a deeper understanding of why this project was so successful and how this success could possibly be replicated with other projects.

The idea that some species' traits make them easier to connect with is not a new one, as the literature has many examples of studies which identify traits that make animals more popular

among the public, which often corresponds with more, and better funded, conservation projects and research. When this topic comes up, the first term that often comes to mind first for those involved in wildlife science is "charismatic megafauna." The term charismatic megafauna refers to charismatic species that are relatively large for whatever group that they are representative of. When one thinks of the birds one may commonly see around Clemson, South Carolina, the barred owl could definitely be seen as a charismatic megafauna species for the area. Barred owls are larger than most other bird species in the area and, as described in the interview data, their appearance and call could definitely be classified as traits that make them seem charismatic among those who see them. The fact that the public was able to form strong connections with the owls, and even were willing to put forth money to fund a project researching them in their community, lines up well with the information in the literature about how people focus in on and care more about larger and more charismatic animals. The fact that the owls are relatively calm and safe to handle under researcher supervision also had a contribution to the success of the project. It would be much harder to have the public up close and personal with a different species that would not be calm and safe to handle unless sedated, such as any species of large mammal or perhaps venomous reptiles.

The fact that the owls were also able to have GPS transmitters attached without any invasive procedures was another very important aspect of the owls that seemed to contribute to the ability of this project to engage the public. The non-invasiveness of the research allowed for the public to be present for all the entire process of interacting with the wild owls. The observation and interaction with the entirety of a wildlife research in progress demonstrated exactly how accessible that this project was for public involvement. This sort of involvement can

contribute more to establishing trust between the public and the scientists (Dickinson *et al.*, 2012).

The fascination with location data described in this study can be connected to the literature on place-based education. Place-based education refers to educational activities that use the local environment and community as a point around which to base learning (Chinn, 2012). Sharing in-depth data about the movement of the owls made the idea of the owl ranges more easily understood and tangible for project participants, who then may in turn come to see their properties as more special. Knowing where in their area the owls moved may have affected participants' sense of place leading to greater place connection. Research shows that strong place connection makes people have a desire to protect the places they see as special, as well as the wildlife that may live there (Rogers & Bragg, 2012). Connecting people with the area in which they live and the animals they share that space with may foster a sense of stewardship.

The findings of this study also aligns with literature on community-based research. Since the project was associated with Clemson University, people were willing to let researchers use their properties as the local community sees the University as an extremely important part of their community. The project therefore aligned with their interests or community values, which has been shown to be important for the success of projects whose components involve working with the public. This could be an especially important aspect for those planning projects that seek to utilize public involvement in similar ways to the Clemson Barred Owl Project to consider during their planning phases. Having the project be associated with some organization or aspect of the community that is valued should be a priority in order to cinch greater community support. (Matthew *et al.*, 2020).

Despite no mention of interpretation in the interview, it is clear that Clément's work on this project, particularly related to the public engagement aspect, reflect Tilden's six principles of interpretation. Freeman Tilden's book *Interpreting Our Heritage* (1957) described interpretation as "an educational activity which aims to reveal meanings and relationships through the use of original objects, by firsthand experience, and by illustrative media, rather than simply to communicate factual information." This definition, and the principles of interpretation Tilden described, were based upon his decades of work observing and designing programming for America's National Parks. Tilden outlined these six principles of interpretation:

-Interpretation that does not somehow relate what is being displayed or described to something within the personality or experience of the visitor will be sterile. Interpretation should be personal to the audience.

-Information, as such, is not interpretation. Interpretation is revelation based upon information. Successful interpretation must do more than present facts.

-Interpretation is an art, which combines many arts. Any art is to some degree teachable.

-The chief aim of interpretation is not instruction, but provocation. Interpretation should stimulate people into a form of action.

-Interpretation should aim to present a whole rather than a part. Interpretation is conceptual and should explain the relationships between things.

-Interpretation addressed to children should not be a dilution of the presentation to adults, but should follow a fundamentally different approach. Different age groups have different needs and require different interpretive programs.

These principles can be seen in Clément's work with the public during the project. Clément allowed the participants to "meet" the owls that live near them and gave them a lot of

new knowledge about the owls and how humans' actions can impact them.This made the owls a more personal issue for them and often provoked them to think more about their impacts and change their behavior in a way that benefitted the owls and their local environment as a whole. By thinking beyond the owls, the participants began to think more about the interconnectedness of humans, owls, and other components of the environment. This was not the initial goal of the project and was not necessarily what Clément set out to do. In a way Clément can be thought of as a "self-taught interpreter" who not only taught the public about owls, but helped them make greater meaning out of their experience which led them to a greater understanding of what it meant to be a good environmental steward. The principle relating to children is even present in the work Clément did on this project. When she brought a captured owl to a group of summer camp children and did her process in front of them, she did not simply water down the normal information that she said, she actually modified the program to be more fitting for children, emphasizing that they needed to keep the voices down and tell their parents to do the same and having the group circle up around her to see the process from all angles. Table 1 outlines how her work lines up with the principles. Tilden's principles can be used as a framework through which connections can be built, which can lead to actual positive actions for the study species. Tilden's book, *Interpreting Our Heritage*, which outlines the principles demonstrated this idea when it says:

> *"Through interpretation, understanding; through understanding, appreciation; through appreciation, protection."*

This quote reflects the importance of helping people understand and appreciate wildlife, which Clément demonstrably did in this project. Participants did want to protect the owls they felt connected to and went on to modify their behaviors to reflect this desire.

Table 1. Table outlining how the Clemson Barred Owl Project connects with Freeman Tilden's six principles of interpretation.

Tilden's Principles of Interpretation	Related Aspects of the Clemson Barred Owl Project
Interpretation that does not somehow relate what is being displayed or described to something within the personality or experience of the visitor will be sterile. Interpretation should be personal to the audience.	The owls that were the focus of the project were present at the participants' homes. The information that they learned and the experiences that they had were grounded in their own area.
Information, as such, is not interpretation. Interpretation is revelation based upon information. Successful interpretation must do more than present facts.	Facts presented to participants were backed up with recommendations on how to help the owls. Interaction with the owls provided something for participants to connect what they learned to.
Interpretation is an art, which combines many arts. Any art is in some degree teachable.	Marion Clément did not start off planning on such a robust public involvement element. This component came up over time and, although not directly trained in interpretation, Clément developed skills in connecting the public and wildlife as the project unfolded.
The chief aim of interpretation is not instruction, but provocation. Interpretation should stimulate people into a form of action.	Owl project participants began taking action to advocate for owls and make their properties as good for owls as possible.
Interpretation should aim to present a whole rather than a part. Interpretation is conceptual and should explain the relationships between things.	The experiences that participants had educated them on the relationships between themselves and the owls. They began to be more mindful of the impacts that their actions had on their owls and on the local environment.
Interpretation addressed to children should not be a dilution of the presentation to adults, but should follow a fundamentally different approach. Different age groups have different needs and require different interpretive programs.	Clément invited a group of children at a summer camp to observe the process after connecting with them during a presentation that she gave to them about owls. This event was not simply a watered down version of the normal experience. Clément added new directions and instructions for this particular event. Most experiences also involved families, including children, so Marion was always addressing both children and adults.

The traits of a successful facilitator of human-wildlife connection, as seen in this project, are not necessarily a limitation, even if a researcher feels that they are missing them. These are traits that can be developed with practice and professional development. Much like interpretation, which also focuses on the formation of connection to a degree, these components of a good facilitator can be taught to those wanting to involve the public in their research. The 3rd principle of interpretation as outlined by Freeman Tilden states that interpretation, like any other art, is to some degree teachable (Tilden, 1957). The art of connecting people and wildlife can be viewed in the same way.

When the public has trust in science and the scientists involved, they are more likely to support the goals that their research recommends. For this reason, it is critical that researchers who invite the public to participate in their research foster a sense of trust and approachability, which can be achieved by being polite or respectful. A patient researcher who is up front and honest with project participants is more likely to have their knowledge and recommendations accepted by the members of the public that they communicate with (Rose *et al.*, 2020).

The ability to simplify science without diluting it and losing critical information when communicating with the public is an important one for any researcher wanting to work with the public. Translating scientific concepts, especially in a way that expresses the researcher's passion for the science, has the potential to build up scientific literacy and enthusiasm for conservation in the public (Toomey *et al.*, 2020).

Comparing the results of this study with the themes found in the Clemson Barred Owl Project participant interviews may provide insights into how different aspects of the project and researcher may have influenced the individual outcomes identified (Table 2). The specific traits of the barred owl and the non-invasive nature of the project which allowed people to be able to

have up close interactions with the owls may have contributed directly to the increased feelings

of connection found in the participant study. The use of location data that shows participants how

the owls are moving around their area and the researcher's enthusiasm for the research and the

target species may have also played a role in increasing these feelings of connection. Pro-

environmental intentions/behaviors, as well as the desire to be better wildlife advocates, may

have been influenced by the use of location data and the aspects of the researcher who

communicated new knowledge about the owls and their habitat to the participants, such as an

approachable nature, enthusiasm for the science, and proficient science communication skills.

The admiration that many participants formed for Clément may have been caused by her

approachability and her passion for the owls and her project involving them. The fact that

location data was shared with participants and the support that a number of community members

already were ready to give to the project may have had a contribution to the building of a

community based around conservation.

Table 2. Table outlining which themes gathered from the interview with Marion Clément may have contributed to the themes found from the Clemson Barred Owl Project participant interviews.

Participant Outcome	Contributing Factor(s)
Increased Feelings of Connection	Owl Traits Non-Invasive Location Data Researcher Enthusiasm
Pro-Environmental Intentions and Behaviors	Location Data Approachable Researcher Sci-Comm Researcher Enthusiasm
Environmental Advocacy	Location Data Approachable Researcher Sci-Comm Researcher Enthusiasm
Admiration of Researcher	Approachable Researcher Researcher Enthusiasm
Building Community of Conservation	Location Data Community Support,

Theme #1="Owl Traits", Theme #2="Non-Invasive", Theme #3="Location Data", Theme #4="Community Support". Theme #5="Approachable Researcher", Theme #6="Sci-Comm", Theme #7="Researcher Enthusiasm"

Limitations

The primary limitation of this study is that it is entirely focused on the success of one wildlife research project and the experiences of one researcher. This means that the aspects of the project design and the traits of the project's talented researcher may not be representative of the diverse range of researchers and projects that make up the field of wildlife biology. This study's findings may not be applicable to studies involving different species, locations, or methodologies, but that does not mean that the information presented is not valuable. Case studies such as this one can be used to build a base understanding off of which future research can be built (Flyvbjerg, 2013), and that is exactly what this study seeks to do. The hope is that this research will inform future researchers on what aspects of projects involving the public could be focused on and, hopefully, the results of this research will also be used by researchers who are planning future wildlife research projects as a foundation off of which they can build and learn from their own results.

Future Directions for Research

Future research into projects which involve the public in wildlife research should aim to gain a more robust understanding of the topic by studying a wide array of projects based around other species, other areas, and various methodologies. Comparative studies would be a useful way to do this as they could reveal which factors have the strongest impacts over others. Longitudinal studies that focus on the effects of a project over time could also be helpful, as the long-term effects of public involvement could be better understood.

Another direction that future research could take would be delving deeper into the ability that virtual public involvement has to increase interest and engagement in conservation. Virtual engagement could make involvement more accessible and extend a project's reach. Based on the

results of this study, research should probably focus on ways to allow the public to interact with professional wildlife researchers in this virtual setting, as the researchers themselves seem to have a significant role in the success of public involvement.

Conclusion

The themes identified by this study highlight the significance of inviting the public into wildlife research, the pivotal role of open and effective communication, and the ability of a talented facilitator to potentially foster an informed and emotionally connected community of local environmental advocates. The narrow focus on one specific successful project means that these results may not necessarily be generalizable, but this limitation does not mean that the Clemson Barred Owl Project and this study can not be used as a foundation for future studies into the dynamics of inviting the public to participate in wildlife research.

To conclude this paper, here is one last quote from the interview with Marion Clément. She describes other projects that have been inspired by the Clemson Barred Owl Project that may lack the strong focus on public involvement that the original project had and describes the impact that this project had on her life and the lives of others, while expressing a hope that her study will lead to other impactful research projects in the future:

> "*Since the project ended there's a number of spin-offs. There's a paper that's about to be published where they did a similar study in Louisiana, but maybe not as much of a social focus as this one, and there's people in Canada that are trying to replicate it. It's interesting how even though I've stepped away from it, it continues to knock at my door, which is so fun. It's probably the project that I'm the proudest of in my life. So I think about it very fondly, and it has left as much of a mark, if not greater on me, than it has with the people that you've interviewed who participated in this project. I do think*

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something special happened in Clemson with this project, and I am glad that you're able to highlight it, so that perhaps it can be replicated with a different structure and within a different community elsewhere and I'm certainly hopeful that I can replicate it at some point in my job as well."

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CHAPTER 4

RAISING TROUT AND SCIENTISTS: EFFECTS THAT PARTICIPATION IN A CLASSROOM WILDLIFE PROJECT HAS ON STUDENTS

Abstract

Trout in the Classroom is a STEM education project sponsored by Trout Unlimited that involves students raising trout from eggs to a releasable size before releasing the fish into the wild. Goals of this project include educating students about water quality and aquatic habitats but participation in the project may have had secondary effects. This study utilized interview and survey data from students who participated in the project and educators who use it in their curriculum to understand whether the project changed students' feelings of connection with a local species. Results suggest that participation increases feelings of connection and instills pro-environmental ideals in students. Some students also begin to see themselves as part of the scientific process as a result of participation in the project. This information could be used to design new wildlife education projects for the classroom.

Introduction

Fostering a connection between youth and nature has been the focus of professionals in several fields, including youth development, environmental education, and conservation, for decades (Bowers et al., 2021). Studies show that children do spend more time outside now than they have in past years (Martin et al., 2023) however, youth on average still spend more time indoors, with a significant amount of that time spent looking at a screen (Muppala et al., 2023). There are a number of barriers that prevent youth from having meaningful experiences in nature including lack of access to natural areas, feelings of danger in the outdoors on the part of children or their parents, and a lack of spare time to have nature experiences around all of their school or extracurricular activities (Waite et al., 2023). For this reason, one possible solution to this loss of connection is to find ways to incorporate nature experiences into the classroom through environmental education (Sukma et al., 2020).

Environmental education is defined as education that "is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated, aware of how to help solve these problems, and motivated to work toward their solution" (Stapp, 1969). Environmental education has been shown to increase feelings of connection and place attachment (Kudryavtsev et al., 2012) Instilling these feelings in youth has the potential to lead to even stronger feelings of connection and pro-environmental intentions later in life (Křepelková et al., 2020). Incorporating environmental education programming into lessons, whether they be in the classroom or on field trips have been successful in both making youth more aware of environmental issues and making them think more about how their actions affect wildlife (White et al., 2018). One type of project that has the potential to impart unique lessons on students, that may be harder to elaborate in less direct ways, are projects in which students

particiThere are projects involving the raising of aquatic animals in the classroom have been around for decades, occurring at all levels of education from elementary to university. Some of these projects focus on aquaculture, which is defined as the rearing of aquatic plants and animals for food (Mizuta et al., 2023). There are also programs of this type that may use some principles of aquaculture, but instead have a focus on environmental education, teaching students about the habitats, life cycles, and issues facing many different species of aquatic organisms (Bagarinao, 2007). The species grown as part of these programs vary and some of the species reared in these environments include American Shad (Corrozi Narvaez & Lucas, 2014), Diamondback Terrapins (Herlands et al., 2004), and Horseshoe Crabs (Kwan et al., 2017). One of the most common groups of animals grown in these classroom projects, due to their importance to the environments in which they live and popularity as game fish are Salmonids, such as salmon and trout (Baumer & Hansen, 2016).

One of the widespread and successful of these aquaculture programs is the Trout in the Classroom program (TIC) (Dickler et al., 2006). TIC is a program sponsored and organized by Trout Unlimited and the Department of Natural Resources in various states. TIC is typically done in courses focused on environmental science, biology, or agricultural education. The program is advertised as a "gateway to stewardship" for students at all levels. As part of this program, classrooms can receive necessary supplies from these organizations, as well as trout eggs. Over the course of several months students are asked to assist with the monitoring of water quality, cleaning of the habitat, and the feeding of the young trout once they have hatched. Students are also asked to observe the trout, taking down notes on trout development and learning more about their life cycle. At the end of the project, the classes often participate in a trout release field trip, where students are allowed to individually release the trout that they have

raised into a local body of water as part of state trout stocking programs. On these trips students are also typically exposed to more environmental education from Trout Unlimited and Departments of Natural Resources.

Anecdotal evidence points to this program promoting feelings of ownership over the trout and this project and emotional connections to the fish themselves. These claims make sense, as the literature suggests that close interaction with animals promotes deep, emotional connection. Since a connection with wildlife can lead to a stronger connection with nature, it makes sense that TIC could be a possible solution to bridge the gap between people, specifically young people in this case, and nature. The purpose of this study is to examine how interaction with trout during the TIC program has the potential to change students' feelings of connection with nature, which may in turn lead to more pro-environmental intentions. Specifically, this study will address the following research question: How does participation in a classroom project based on a local species affect participants' feelings of connection to local wildlife?

Methods

Approach to Research

This research uses semi-structured interviews to examine student participation in Trout in the Classroom by citizens using the epistemological frameworks of constructivism and phenomenology to build an understanding of the "invariant" essence of their experience with the project. Attention will be paid to the overlap of the experience for most or all participants.

Description of Data Sources

This study uses three sources of data to answer its research questions. The first two were semi-structured group interviews and surveys that were conducted with two high school common placement environmental science classes at D.W. Daniel High School (Daniel High School) in

Central, South Carolina. The teacher of these classes allowed researchers to attend and observe

the classes' trout release, to form interview questions to ask during class interviews. Informed

consent forms were received from all students who participated in both the interviews and

surveys prior to their participation and no identifiable data was collected. These classes were

made up of students ages 15-18 of mixed ethnicities and genders (Table 1). The third data source

was a survey that was given to teachers from both North Carolina and South Carolina who run

Trout in the Classroom programs in their classes. A Google Forms survey link was given to

North Carolina and South Carolina state TIC coordinators for distribution to all of the instructors

who use TIC in their states. These teachers taught at various levels from elementary school to

college and have various levels of experience with TIC, having taught the program from 1-15

years.

Table 1. Trout in the Classroom participant survey demographic data

Survey Participant	Age	Ethnicity	Gender Identity	Primary Language at Home
Participant 1	18	Caucasian	Male	English
Participant 2	18	African-American	Male	English
Participant 3	16	Caucasian	Female	English
Participant 4	16	Caucasian	Female	English
Participant 5	16	African-American	Male	English
Participant 6	17	Latino/a or Hispanic	Female	Spanish
Participant 7	18	Caucasian	Male	English
Participant 8	16	Two or More	Female	English
Participant 9	18	African-American	Male	English
Participant 10	18	Caucasian	Female	English
Participant 11	17	Caucasian	Prefer Not to Say	English
Participant 12	18	Caucasian	Male	English
Participant 13	18	Caucasian	Female	English
Participant 14	16	Caucasian	Female	English
Participant 15	18	Caucasian	Male	English
Participant 16	17	Caucasian	Male	English
Participant 17	15	Caucasian	Female	English
Participant 18	17	Caucasian	Female	English
Participant 19	16	Caucasian	Male	English
Participant 20	16	Caucasian	Female	English
Participant 21	16	Caucasian	Male	English

This study was was able to examine a hands-on wildlife science project in progress. Researchers were able to be present throughout multiple stages of the project and student group interviews were able to be conducted as soon as possible after the conclusion of the project.

Study Sites

D.W. Daniel High School is 1 of the 4 public high schools serving Pickens County in upstate South Carolina. According to U.S. News and World Report, using data from the 2021-2022 school year, Daniel High School is ranked #13 in South Carolina and #1,871 in the United States based on "performance on state-required tests, graduation and how well they prepare students for college" (U.S. News and World Report). 75% of Daniel High School students are proficient in science according to applicable standards. According to the same report, the school's gender ratio is almost evenly split at 49% female and 51% male (no mention is made in this report about students who identify outside of the gender binary). Total minority enrollment at the school is 24% (exact demographics can be found in Table 2) and 29% of students are classified as "economically disadvantaged.

Table 2. D.W. Daniel High School demographic and other school data

Factor	Measure
Race	
White	**75.7%**
African-American or Black	**8.1%**
Latino/a or Hispanic	**7.3%**
Two or More Races	**5.9%**
Asian	**2.8%**
American Indian or Alaska Native	**0.2%**
Ethnicity	
Male	**51%**
Female	**49%**
Other Data	
Total Enrollment	**1,194**
Student-Teacher Ratio	**20:1**
Advanced Placement Enrollment	**54%**
Graduation Rate	**92%**
Total Economically Disadvantaged	**29%**

The second study site is much broader, as it encapsulates both North Carolina and South Carolina. Specifically, the schools in these states that have classes which utilize Trout in the Classroom in their curriculums.

Class Interviews

Two semi-structured class interviews consisting of open-ended questions, which utilized a modified Seidman approach were performed as part of this study. The modified Seidman approach, combining all three interviews in the series outlined by Seidman into a single interview, was chosen in order to not take time away from the teacher's lesson plans. Three 90 minute interviews would be extremely difficult to conduct with the classes that this study focused on due to the fact that class periods were less than 90 minutes and to conduct three separate interviews during class time would take up three of the teacher's class periods, which was impossible as it would impede the instructor's ability to teach all of the lessons planned for the course. The Seidman approach normally utilizes three 90 minute interviews focusing on a focused life history, details of the experience, and reflection on the meaning (Seidman, 2006) Group interviews with the entirety of both classes were chosen over individual interviews because the literature points to this strategy producing richer datasets in this setting by allowing students to elaborate and provide more detail based on other students' responses (Lambert & Loiselle, 2006).Interviews were broken into three sections, these sections being focused life history, the details of the experience and reflection on meaning. The full list of interview questions can be found in Appendix C. Questions in the focused life history section focused on the students' past experiences related to the subject of the interview (i.e. "Do you have prior experience with trout or other wild fish before this class?") . For the details of the experience section, students were asked to describe their experience with TIC. The reflection on meaning

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section focuses on questions regarding students' thoughts on and emotions connected to their experience in TIC over the course of their environmental science class (i.e. "Do you feel more connected to trout or wild fish following your involvement in this project?"). The full interview script can be found in Appendix C.

Both interviews were done on the same school day with two researchers conducting the first interview, and one of those researchers conducting the second. The first class was made up of 14 students and the second was made up of 18 students, for a total of 31 students. The two interviews were recorded using a single microphone connected to a laptop computer using Audacity audio recording software and transcribed verbatim by a researcher for later content analysis.

Class Surveys

Following the class interviews, students were given a Google Forms survey with the same open-ended questions that were posed to them in the interview along with some basic demographic questions. The survey instrument can be found on Appendix D. The purpose of this survey was to capture additional data from students who may not have wanted to speak up during the interview, but still were willing to share their experiences. Out of the 31 students who were asked to participate, 21 completed the survey making for a participation rate of 67.7%.

Teacher Surveys

In order to gather more data on the effects of participation in TIC on students, surveys were sent to North and South Carolina teachers who use the TIC program in their classes. TIC state coordinators worked with researchers to send Google Forms surveys out to 60 schools with instructors participating in TIC. Out of these, 10 instructors chose to participate, which points to a participation rate of 16.7%, although it is impossible to know how many instructors received or

saw the invitation to the survey. It can be difficult to determine the participation rates of surveys

distributed through secondary sources for this reason (Whittington et al., 2017). As with student

interviews and surveys, the teacher survey consisted of open-ended questions and followed the

basic Seidman structure of three sections made up of "Focused Life History", "Details of the

Experience", and "Reflection on the Meaning" . The focused life history section contained

questions pertaining to instructor's reasons for beginning to use TIC in their classrooms and

background information on their participation (i.e. "What made you pick up the Trout in the

Classroom program?"). The details of the experience section focused on instructors' observations

regarding their students' participation in TIC (i.e. "Have you seen or heard anything that

indicates that your students feel connection with the trout that they are helping to raise?"). The

reflection section focused on instructors' perceived changes in their students following TIC

participation, as well as their own feelings after being a part of the TIC program (i.e. "Have you

seen or heard anything that indicates if your students are thinking deeper on environmental issues

during and after Trout in the Classroom? (i.e. clean water, habitat health, etc.)"). The full list of

interview questions can be found in Appendix E.

Data Analysis

Data analysis of the class interview data, as well as the two surveys, involved the reading

and coding of the interview transcripts. The idea behind the thematic coding of the transcripts

and surveys is firmly rooted in phenomenological research. Phenomenological research is based

upon the fact that "truth" exists within an individual's mind, stemming from their experiences

instead of just being observable from their experiences alone (Hanford, 1975). The interviews

and surveys of this study seek to extract some of that truth. If common themes can be found in

the thoughts and feelings of several participants, these may be considered some of the universal

traits of a particular experience. Since this research focuses on the personal experiences of participants and instructors of Trout in the Classroom programs, phenomenological research methods are the most logical choice.

Data from all three sources was analyzed using MaxQDA qualitative data analysis software. The interview transcripts and survey responses from this study were broken down into single statements and these statements were coded thematically (Moustakas, 1994). The codes used for interviews consisted of both *a priori* and open codes. *A priori* codes consist of categories determined prior to the beginning of coding that are critical to the investigation of the research questions, including human-wildlife connection and any changes in thought or feeling related to participation in science (Creswell, 2007). The act of open coding allowed for any common themes found during the coding process that did not fall into the *a priori* categories (Williams & Moser, 2019).

Results

Student Results

This set of results is based on the class group interviews and surveys, which asked the same questions of the students in both classes. Despite each class interview lasting approximately 90 minutes, most students chose not to speak up and give their perspectives on the process, possibly due to nervousness speaking in front of their classmates or the researchers (Ahmad, 2021). The researchers present performing the interview also noted a level of apathy present among some of the students, with some choosing to use the interview time in order to do other personal activities. This level of apathy led to the addition of a question to the interview given to TIC instructors asking whether or not they observed apathy to the TIC program in their classrooms. Apathy is among the concerns that youth development professionals have described

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as a barrier to youths' connection to nature (Silverman & Corneau, 2017). For these reasons, the class interview yielded less data than initially expected, although enough statements were made for a thorough thematic analysis.

The two *a priori* codes regarding changes in feelings of connection and the fostering of pro-environmental intention were able to be identified in the interview transcripts and survey data, as well as two other major themes discovered through open coding. These three additional themes dealt with feelings of responsibility, and awe/curiosity. There were a handful of comments that indicated some minor negative feelings regarding the project that will also be addressed, as even these infrequent negative comments can shed light on how students feel about their experiences with Trout in the Classroom.

Theme 1: Participation causes positive changes in students' feelings of connection to wildlife or the environment as a whole.

Although many students stated that they have had wildlife experiences and may even feel some level of connection due to those experiences, none of the students present in the two class groups interviewed directly stated that they felt a change in connection to wildlife, but their statements demonstrated connection through their care for and worries about the trout in their care. The classes' grades are not reliant on trout survival and more trout will be provided for the trout release if all of the classes' trout do not make it, so their concerns for their trout may be based on emotional connection. Since connection can be defined as emotional bonds based on experience (Barragan-Jason et al., 2023) we can identify these statements as connections to the trout fry. Students spoke about their concerns for the young trout both while they were in their care, and after they had been released into the wild. Among the utmost importance of trout health

while they are in their aquarium in the classroom is the monitoring and adjustment of water quality. Most simple tests used to monitor water quality in aquaria involve reagents that react to different levels of water parameters by changing color, indicating whether the parameters are at a level that is healthy for fish or not. The statements of concern for the trout while they were in the care of the class included multiple comments regarding students' feelings of worry for the fish when the water parameters may have diverted from where they should have been:

> *"'Why is it purple? Why is the water purple? This isn't good. Why is it purple?' It*
> *mattered."*

Another student expressed similar feelings in the following quote:

> *"I did the levels, and I was a little worried, but I think I did well."*

As stated above the students' concern for the trout that they raised from eggs extended beyond their time with them. Students indicated that they were thinking about the trout's health in the stream and whether or not they would make it down the stream to an area where students believe the trout would be safe:

> *"Whenever we raised them in the tank, really all we were worried about was their*
> *conditions. So I mean, whenever we released them, that was the big problem, is how they*
> *would be after they were released."*

Another student in the interview delivered a similar comment which actively questioned out loud the fate of the fish that they raised. The trout were released into an upper pool which fed into a stream, and then a small lake:

> *"I think that probably a lot of fish made it down. You know? I heard something like that."*

Since connection to nature has been shown to increase pro-environmental intentions, the fact that participation in the project seemed to cause students to show greater pro-environmental intention should come as no surprise.

Theme 2: Participation fosters new, or strengthens pre-existing, pro-environmental intentions.

Many of the students spoke about how their participation in this project interacting with the trout and monitoring their water parameters made them think more about the environment and their impact on it. Statements relating to this theme mostly related to being mindful of aquatic habitat health and acknowledging that they can do things to lessen their impacts on these environments. When asked if this experience made them think about regarding their impacts on the environment one student stated:

> *"I would say yeah. Like, I know definitely now that when we go out on the lake this summer, I'm going to take a little bit more care. Like, if I eat something or if I drink something, to make sure that it gets thrown away properly so it doesn't, like, get into the lake or things like that. Like, make sure we pick up after ourselves if we go park on a sandbar or something, just so we don't, like (teacher's name) was saying, you don't want to put that into the water and worry what's happening to fish habitats based off of what I did."*

Another student gave the following response to the same question, demonstrating an intention to clean up waterways:

> *"I mean, just cleaning the water systems up to make it something that the fish can enjoy, the ducks, the herons, whatever. Make it a better habitat for them."*

One student gave this brief comment when asked the same question. A desire to conserve the environment was well-documented in the data:

"I mean, you want to protect the environment."

The fostering of pro-environmental ideals did not apply to every student, which is shown by one student's direct statement when asked if they would be more likely to make more pro-environmental decisions in the future. The student simply said:

"I would say no."

Theme 3: Raising trout from eggs in the classroom made students think more about their current and future responsibilities.

One of the major themes identified by open coding was the fostering of feelings of responsibility in the students. The students cited the trout's reliance on them as the main reason for these feelings. They related their responsibilities to the trout to their responsibilities in high school, as well responsibilities they may have in the future. One student stated that their work for the trout may prepare them to give more attention and care to things when they are adults. The students recognized that they were the ones accountable for the health and survival of another living thing:

"I feel like it shows how much care and attention you have to show to a lot of things. Like in high school, we have a lot of things set up for us, so as you get older, you have to show a lot more attention and care into things as you get older. I think that's probably a good start with having to check all of the levels and everything like that and being held accountable. If you don't do a good job, a lot of the trout will suffer from it."

Another student took this responsibility to a new level, likening themselves to a parent:

"'Because it's an animal? I don't know. It kind of made me feel like a parent. I don't want anything to go bad because they're babies."

Theme 4: Observation of trout and deeper thought into their life in the wild kindles new feelings of awe and curiosity.

Caring for the trout and finding out that it took a lot of effort on their part made some of the students in the two classes interviewed amazed that they could survive out in the wild on their own and curious about how this is possible. There was a sense of wonder when it came to the ability of these trout to live on their own in the wild without the intervention of humans:

"It was crazy how important it was to take care of the tank so they all would live."

Another student made a similar statement which indicated a sense of awe at the complexity of aquatic systems:

"Because this is just a classroom. If you're in an ecosystem, it just seems like it would be ten times harder."

This student made a comment about the trout were able to survive on their own in the wild with a tone of bewilderment:

""They know how it works. Like with them growing up, we have to do so much, but once they get out there, they're just perfectly fine."

This wonder seemed to lead directly into questions about the trout's ability to survive without them:

"What is like main difference? Does it make a difference at all between growing them in a tank versus when they hatch in the wild?"

Some students had questions about how it was even possible for the trout to survive in the wild when it took so much work to keep them healthy in the classroom:

> *"'What makes a different body of water so much more clean than another, and like, with the processes that we were doing, like why are some better at those processes naturally than others? Just because it's one big pond, I guess. What would make a difference?"*

Association with the young fish in the classroom made some students more curious about the fish that they see in the wild. This comment is reflective of this curiosity:

> *"I live out on the lake, so now I'm looking and seeing and wondering how old those little fish are, or what type of fish those are, and being a little more intrigued for sure, just having that experience."*

Not all of the students interviewed and surveyed for this study felt the same way. Several of the students expressed a level of disinterest with issues concerning the environment.

Negative Comments Regarding Trout in the Classroom

Negative comments regarding the students' experience with Trout in the Classroom were not common by any means; however, a couple of students did make statements that indicated some level of disappointment or frustration with the project. Many students made statements about the complexity of the tests done in the classroom to monitor their aquarium's water quality, but one student in particular very directly stated their negative feelings regarding the work done in the classroom:

> *"I mean it's a cool idea, but I can only remember how much I hated the smell. It made me gag and I apparently detest the smell of fish. ALSO the test I was told to do was so long*

and stressful. Another thing was everyday I went over there to check, a new fish was dead

so I felt bad."

Another student described their feelings regarding the amount of thought and effort that goes into

the tests in a negative manner. The following statement was made with a negative connotation:

"It's a lot to understand. It's just a little bit more complicated."

One student expressed that they were left out of one significant part of the Trout in the

Classroom experience due to the number of trout that made it to the release:

"It was fun. I didn't get to release a trout though."

Some students indicate feelings of apathy about the environment even after participation

in Trout in the Classroom. Although many students did state their feelings of connection for the

trout and some mentioned their desire to have better environmental behaviors, a handful of

students made comments that reflected a lack of interest in nature or spending time outdoors.

These statements were typically made in response to questions regarding student's pro-

environmental ideals or if they thought they may go down a career path related to the work they

did for this project. The following quotes are representative of these feelings:

"I dislike spending my time outside"

The following quote is from a student who did not have much to say in their responses to the

post-interview survey:

"I'm not a big fan of fish and wildlife"

This sentiment can also be seen in neutral comments regarding whether or not students thought

that their connection to trout would lead them to think more about the environment, such as:

"Maybe, maybe not, I really don't know honestly."

Comments such as these did not come from all students however, their presence is notable given the class that they are participating in is an elective environmental science course.

These major themes demonstrate some of the emotions and intentions that were prompted by the student's experience with Trout in the Classroom. The prompting of feelings of responsibility and awe leading to curiosity were not among those expected before this study; however, they make sense given the details of the experience and foundations for these feelings do exist in the literature.

Teacher Results

The teacher survey reached teachers who, when combined, teach the Trout in the Classroom to over 800 students in North Carolina and South Carolina. These teachers are delivering the TIC program to students from elementary school to community college and at different academic levels (common placement, honors, advanced placement). Their experiences incorporating the program into their classes and their observations of their students who participate can give us another perspective on the effects of participation in TIC on students' feelings of connection. Statements that represented the two a priori codes were present in the survey data, as were four other major themes that became evident during the coding process. These inductive codes involved student enjoyment of the project, teacher engagement, some teachers focus on the non-scientific aspects of the project, and how the Trout in the Classroom program makes students begin to identify themselves as scientists.

Theme 1: Participation causes positive changes in students' feelings of connection to wildlife or the environment as a whole.

As with the data gathered from the two classes of students who participated in Trout in the Classroom, the survey data gathered from TIC instructors reflect a connection made between the students and the trout that they raised in the classroom. All but one of the responding teachers stated that they have seen or heard indications that their students seem to be forming connections with the trout that they raise. This solo teacher stated that they saw no connection between the students and the fish, but they did indicate that students seemed interested in the fish as they performed their daily maintenance. All of the rest of the teachers stated that students made connections and discussed connections made at different points in the project. When asked if they observed any indications of student connection, some of the following responses were given regarding connections made in the classroom:

> *"Yes, many students walk over to the tank upon entering the classroom to check on them.*
>
> *They are really excited to see them, especially on a Monday."*

Another educator made a similar comment stating that their students were also always very eager to check up on the trout they were raising:

> *"Yes - I always have students that check on the trout everyday whether it's their turn or*
>
> *not. They worry when we're in transport up to (trout release location) about them*
>
> *surviving the bumpy ride."*

The trout release day seems to be another point of connection to students. Teachers described students wanting to make sure that the streams in which trout were released were healthy enough for the trout to survive in. One teacher gave the following response regarding connections made on these trips:

> *"The connection usually takes place during trout release day, but when students want to*
>
> *name them and feed them, these are caring connections that are important."*

One more unique statement about connection was made by a community college educator who uses the Trout in the Classroom program. This particular instructor is part of an academic program that puts special emphasis on zoo and aquarium science. Zoos and aquariums use live animals as ambassadors for their species, exposing the public to animals in captivity in order to help them connect more to animals that they may not get to see in the wild (Clifford-Clarke et al., 2021). This educator gave the following response:

> *"We kept one trout that wasn't released by another school. They named it "Steve" and most folks in the program know of him. That type of animal-human connection is impactful."*

Theme 2: Participation fosters new, or strengthens pre-existing, pro-environmental intentions.

The theme of Fostering of Pro-Environmental Intentions was found multiple times in the teacher survey data however, this code was not as common as it was in the student data. Most of the statements made that reference any sort of pro-environmental thoughts are related to students' concerns regarding water quality, which makes sense given the emphasis on water quality monitoring in this project. Some of these comments, made in response to questions about observations on student's pro-environmental thoughts included:

> *"Yes, they often relate the health of the fish and tank to topics we discuss in class, such as water pollution, N cycle, algae blooms, range of tolerance, etc."*

Another teacher observed their students trying to gauge if the water that they were preparing to release their trout into was healthy enough for the fish to survive:

> *"They do look at the stream when we go to release to make sure that the water looks*
>
> *clean and has the requirements of a trout habitat."*

Teachers also described students thinking more about the conditions that trout need to survive in the wild. The conditions in the classroom aquaria are very controlled, unlike those of the streams in which the trout live naturally. One teacher described this awareness of the conditions trout need in the wild with the following statement:

> *"Positive - I think my students get a new understanding of the difficulties facing offspring*
>
> *simply for survival"*

Theme 3: Teachers observe overall signs of enjoyment from students who participate in Trout in the Classroom.

Every survey respondent stated that their students had positive and enjoyable experiences participating in the Trout in the Classroom program. When they go into specifics, teachers cite the trout release trip as the most enjoyable part of the experience for students:

> *"They really enjoy connecting with nature during the release day."*

Another educator seemed to indicate that all of their students reported to them that they at least enjoyed the trout release day:

> *"Every student that has went on the trout release has provided positive feedback. It is a*
>
> *great hands on program that allows us to diversify instruction in the classroom even*
>
> *more."*

Teachers classified the overall experience that students seemed to have in their classrooms as positive, with one response in particular expanding this statement to include more than just the students, including others related to the education setting:

"Almost all the kids love it. Positive."

A different teacher made a similar statement but expanded their answer to inform researchers that other visitors besides the students also got a lot of enjoyment out of the project:

"Very positive, not just for the students but for guests and administration as well."

Theme 4: Teachers indicate that they are also very engaged in the program, and learn more about the target species alongside their students.

The teachers surveyed were all very engaged with the program. All of the teachers indicated that Trout in the Classroom added additional time to their work weeks, yet still saw it as a positive program. While some chose to continue the program after inheriting it from another teacher, many teachers reached out to Trout Unlimited themselves after hearing about Trout in the Classroom. This level of engagement can be found in numerous statements from the survey data including this statement in which a teacher outlines the importance of the program to their teaching philosophy:

"Natural settings are a big part of what I do, and I try to show the benefits/importance of taking time in nature (plants, water, animals, etc.). I enjoy having the trout in the classroom because it fits right in with my teaching beliefs."

Another teacher stated their own connection to the program in a unique way, by connecting the trout and human very directly and explaining how they use TIC in order to connect to more advanced ideas:

"I already consider all vertebrates to be fishes, myself included, and promote deep ecology as part of the program."

Finally, some teachers expressed that the Trout in the Classroom program was educational not just for their students, but for them as well. This sort of engagement in the program is very interesting, as it shows that classroom projects like this have the potential to teach people at many different levels:

> *"I do. I have learned a lot through this program about trout and trout habitat, and I feel as though I have a responsibility to help preserve these types of environments and these fish."*

Another educator indicated that the project was almost like a professional development project for them, expanding upon their knowledge and improving their skills as a teacher:

> *"I enjoy learning and participating in a new activity and working on ways to better in the year(s) to come."*

Theme 5: Teachers observe students taking greater interest in science because of their participation in the project.

Most of the teachers made indications that their students either seemed to feel as though they were involved in science, or, in the case of a teacher who was just getting started in the project, believed that they would after future lessons. This particular educator said the following when asked if they had observed anything that made them believe that their students feel as if they are involved in science:

> *"Not yet, but it is my goal to begin collecting sediment and monitoring temperature fluctuations with my students from a nearby stream. I'm hoping the collection of data will help them see themselves as scientists"*

Another teacher answered the same question with the following response, showing that students may need to advance a bit further before they fully connect their experience with science:

> *"Yes, but usually from students who have completed the course and had time to digest the experience."*

One teacher even seemed to be describing one of their students as a budding science communicator:

> *"I have a student who was struggling and now looks up information about trout and likes to share it with his classmates."*

Theme 6: Some teachers choose not to emphasize the importance of the "scientific aspect" of the Trout in the Classroom program.

The most unexpected discovery made from viewing the teacher survey data is that multiple teachers, although not a majority, stated that Trout in the Classroom's importance does not come from any of the scientific aspects of the project and that their students do not see themselves as scientists. This is interesting given the fact that Trout Unlimited directly describes Trout in the Classroom as a STEM (Science, Technology, Engineering, and Mathematics) project. It seems as though these statements do not match up with the intent of the project. For example, some teachers stated that they either did not focus on the "science side" of the project when asked if their students had made any indications that they felt as if the project made them feel involved in science or research:

> *"The experience is what makes this program beneficial, as opposed to the science/research side of things. Students learn best by doing, and it's the experiential*

learning that takes place during release days that kids will remember for the rest of their

lives. That is what we should remain focused on."

One educator suggested other identities that their students may associate with more than the role

of scientist:

"Not Really; agriculturalists, producers, would be better words. We don't necessarily

stress the science side of things, but more on the practical and real-world factors such as

economics, responsibility of taking care of living things, work ethic."

This contrast in what aspects of the project are stressed most likely depends on the individual

teacher or the subject of the class that the program is being used in. This avoidance of focusing

on the science aspect of the project may result in students not seeing themselves as participants

in science, as is described in this quote:

"No. They don't see the tank water tests or the raising of the trout that they do as a

science experiment."

It is interesting that some of the teachers do not see TIC as science, as it seems to match up with

the goals of scientific inquiry. This could be viewed as a negative way to view the project

however, there may be a way to see this theme in a more positive light.

Discussion and Conclusion

The Trout in the Classroom program seems to have the potential to go beyond what is

expected of a typical classroom project, by going past simply educating students on water quality

and game fish and cultivating connections to nature and some level of increased pro-

environmental intention. This potential may extend to other similar projects that involve

interacting with and raising aquatic organisms in the classroom. Insights gained from students

and teachers involved in TIC in both North Carolina and South Carolina suggest that the

outcomes of this project may be similar to other experiences that give the public a connection to wildlife.

The efficacy of the TIC program to promote students' feelings of connection to nature is evidenced by both students and educators, specifically caused by direct work with the trout. This contact with an animal may tap into the same feelings of biophilia that institutions like zoos and aquariums use to try to turn the public into wildlife stewards (Myers *et al.*, 2004). The care and attention that students give to the trout, as demonstrated by students by expressing concern for the trout or by naming a trout in one case, shows that the students have a deeper emotional investment than simply participating in class. The trout seem to be physical representatives of the conservation concepts that modern environmental education tries to impart on the public, acting as an ambassador for the broad or abstract idea of wildlife. Having a solid example of the wildlife that their actions may effect could make environmental concerns feel more tangible, personal, and immediate.

Pro-environmental intentions formed as a result of participation in Trout in the Classroom were more common in class survey and interview data than the teacher survey data; however this does not change the significance of the projects' effects. The connection students developed with the trout and the places that they live seemed to shape their attitudes towards conservation to some degree. These attitudes can be traced back directly to TIC, as the students overwhelmingly discuss water quality and the health of aquatic environments. From this, we can see that the environmental knowledge and intentions formed is directly related to the focus of the project that the students have participated in. This type of finding has been found in other situations in the literature, such as a project focused on tree surveys which built knowledge and connection to forest health among participating students and citizen scientists (Tsipoura & Kelly, 2015)

Both students and instructors seemed to describe a positive reception of Trout in the Classroom. This is a good reflection of the possible motivational benefit of incorporating hands-on environmental education projects into the curriculum. This indicates that the TIC program has similar benefits to activities in other settings that expose students to wildlife species including touch tanks (Silva dos Santos *et al.*, 2020) and field trips to animal care facilities such as rescues or science centers (Caplow, 2019). This enjoyment and engagement may be, in part, connected to humanity's deep fascination and connection with nature, biophilia. Educational programs which use live animals have been shown to be preferred by students in many different scenarios including at zoos (Heinrich & Birney, 1992) and museums (Sim, 2015). Trout in the Classroom's experiential learning model takes advantage of all of these proven benefits of this sort of project. These benefits are in line with current pedagogical research that highlights the intrinsic value of active student participation for fostering a greater understanding and retention of scientific principles (Agwu Udu *et al.*, 2022).

The early exposure to the scientific process is a vital part of preparing students for, and inspiring students towards, future careers in STEM. TIC not only has the potential to give students greater scientific literacy, but to introduce students to simple skills used by professional wildlife researchers, such as water quality testing, animal observation, and the recording of data. Students' level of identification with the role of "scientist" may have varied; however, the details of the interviews and surveys did demonstrate a greater level of interest or engagement with scientific inquiry and wildlife research. The Trout in the Classroom program seems to have a notable contribution to the nurturing of the next generation of researchers and wildlife advocates.

The fact that some teachers did not see the TIC program as a primarily science-focused program was initially confusing, but this may actually demonstrate the flexibility of the program,

reflecting the fact that this program could be incorporated into many different curriculums.Previous research on classroom aquaculture projects show that this type of project, especially in agricultural education classes, can effectively combine both academic and vocational subjects. Students interviewed for this research found that those who participated in aquaculture projects believed that working on these projects not only improved their scientific knowledge, but also made this knowledge more relevant to their possible future careers (Conroy & Walker, 2000). This suggests that the occasional focus away from science found in this Trout in the Classroom study may have merit. The vocational aspect of projects like this can help students prepare for future careers. By focusing on non-scientific elements within Trout in the Classroom, the program is embracing a slightly different career path that students could take besides hard science such as agriculture. This project, while still building science knowledge, should have a wider appeal based on these results.

Future studies on this subject could use quantitative methods as an alternative way to understand how students' experiences may have changed their feelings of connection to nature. This research could also be expanded on by looking at a wider number of classes that use TIC in their curriculum and research on how more diverse groups of students respond to the program.

The results of this study into the effects of participation in Trout in the Classroom has provided results that testify how integrating nature into the classroom can have positive effects. A connection made with trout in the classroom fosters deeper connections to nature and has the potential to create knowledgeable, future environmental stewards. Through it's hands-on experiential learning, the Trout in the Classroom program supports students holistically by equipping them with the intellectual and emotional tools needed to address today's changing environment.

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CHAPTER 6

CONCLUSION

This dissertation is centered on discovering how participation in wildlife science has the potential to contribute to the mending of the human-nature gap and instill the desire to be a good steward of the environment. The three studies which make up this document examined the notable effects of inviting the public to be a part of the science process and the aspects of research projects that have the most potential to foster positive human-wildlife connections.

Major Findings

Chapter 2 of this dissertation sought to gain a better understanding of the effect that inviting the public to be a part of wildlife research has on feelings of connection and pro-environmental intention. Although involving the public in wildlife science is becoming more common in the form of approaches such as citizen science, the practice is still not the norm. The study that was the focus of Chapter 2 investigated a wildlife research project focused on barred owls around Pickens County, South Carolina. Since there was pre-existing anecdotal evidence that this study was especially successful at building strong emotional connections with the owls studied, this study was planned to formally investigate the effects of participation in that project. A phenomenological study using semi-structured interviews with property owners and their families was conducted in order to see what universal experiences were encountered by these participants who had been invited to observe and interact with wildlife research in process. The thematic analysis revealed that participants experienced increased feelings of connection to nature and participation in the process left them with greater pro-environmental intention than they may have had before the project. It was also found that the project built a "community of conservation" in the local community centered around this project, where-in those who experienced increased connection and gained a greater sense of the impacts that they may have on the environment locally spread information about their experience and their new knowledge

among other members of the community including their neighbors, classmates, and patients. Also of note was that participants often praised the primary researcher of the project for her ability to facilitate connections between public and wildlife. This information, as well as the other results pointing to the project being successful at fostering these connections led to the case study which makes up Chapter 3 of this document.

Chapter 3 was focused on discovering what about the project and the researcher behind it, Marion Clément, made it so effective in engaging the public. This chapter was a case study of this single project which used an interview with Clément with the goal of determining which attributes of the project led to its success. It was determined that multiple aspects of the project design and some traits of the researcher likely contributed to the overall establishment of strong feelings of connection with a local wildlife species. It was found that certain traits of the target species (in this case barred owls), the non-invasive nature of the project's methodology, the use of GPS-based location data, and the support of the local community helped to foster connection. Traits of the researcher, such as the ability to build trust with participants, proficient science communication skills, and a willingness to share their passion for the project were also noted as contributing to the project's success. The components of this specific project, which participants and researchers consider very successful at building meaningful bonds between the public and wildlife, could be used by those planning to incorporate a public involvement aspect in future wildlife research projects in order to try to make the most out of their project. This study also could be used as a foundation, from which new research into public involvement in wildlife research could build.

Chapter 4 focused on the Trout in the Classroom program, which involves students raising trout species from eggs to a releasable size in their classrooms. This phenomenological

study was aimed at discovering what effect participation in the project had on the students, specifically focusing on the project's effect on feelings of connection to the species being raised. Interviews and surveys conducted with two classes who participated in Trout in the Classroom and surveys conducted with North Carolina and South Carolina teachers who use Trout in the Classroom in their curriculum in order to understand the effects of participation in the project. Involvement in the project did change some students' perceptions and attitudes towards nature and the results identified multiple themes that demonstrated an increase in students' connection with nature and pro-environmental intentions. Students also reported increased feelings of responsibility and the teachers indicated that students enjoyed the project and some began identifying with the role of scientist, although some teachers chose not to stress the "science aspect" of Trout in the Classroom.
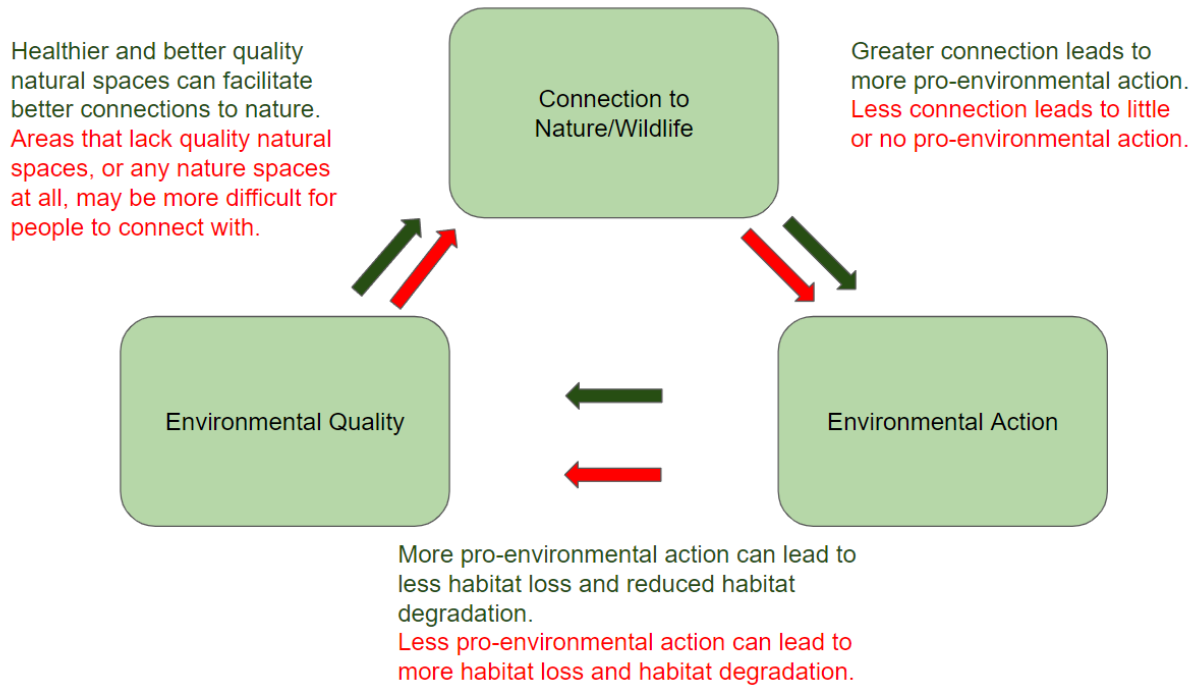
Universal Findings

The global goal of this dissertation was to examine how public participation in wildlife research changes participants' feelings of connection to the natural world and how this may influence environmental action. Based on the findings of the three studies which make up this document, it can be definitively said that close supervised interaction with a local species during participation in a wildlife research project creates or strengthens feelings of connection, which has been shown to lead to more pro-environmental thoughts and actions.

There were other unanticipated findings that came out of this research. The most notable of these is the discovery that participants have the potential to become incredibly engaged in these projects. Those who were involved in the Clemson Barred Owl Project still showed enthusiasm for the project and were excited to speak about it to researchers and other members of the public five years after the project. Information from and support for the project spread

throughout the community, creating potential wildlife advocates out of people who did not even participate in the project, but may have heard about it, either directly or indirectly, from the people who did. This should show the incredible potential that inviting the public into projects such as these have for promoting conservation. This can be traced back to the feedback loop described in the introduction of this document (Figure 1). This research demonstrates that there is merit to the positive feedback loop. Participants described greater feelings of connection and the pro-environmental thoughts and actions that came out of these feelings such as thinking more about their impacts on their local environment and making their properties better places for wildlife. By creating better habitats for wildlife, they may be more present in the area, providing more opportunities to see and interact, which can further strengthen feelings of connection.

Figure 1.

Connection to Nature Feedback Loops

Healthier and better quality natural spaces can facilitate better connections to nature. Areas that lack quality natural spaces, or any nature spaces at all, may be more difficult for people to connect with.

Connection to Nature/Wildlife

Greater connection leads to more pro-environmental action. Less connection leads to little or no pro-environmental action.

Environmental Quality

Environmental Action

More pro-environmental action can lead to less habitat loss and reduced habitat degradation.
Less pro-environmental action can lead to more habitat loss and habitat degradation.

Note. The green arrows and text outline the positive feedback loop and the red arrows and text outline the negative feedback loop. The concepts in the boxes in this graphic are increased in the positive feedback loop and decreased in the negative feedback loop.

The importance of the passion and openness of a researcher to the success of the public involvement aspect of wildlife research projects was also demonstrated. The case study regarding the Clemson Barred Owl Project found that the way that a researcher plans and carries out this type of project matters. A project focused on providing personal, safe interactions with wildlife supervised by an approachable researcher who will share their enthusiasm for wildlife with the public has the greatest potential to impact the way that participants think about and interact with wildlife.

This newly proposed "contemplative" category of public participation in research is one that can be easily deployed by wildlife researchers to get the most out of their projects.

Contemplative projects can go beyond just adding to the body of knowledge relating to wildlife, by involving the public in a way that involves no training, which can still leave lasting impacts related to the way that they think about wildlife and science.

Limitations

This dissertation contains some valuable insights on public participation in wildlife research however, it is not without some limitations. This research was entirely qualitative in nature which, while able to produce very robust data, can limit the generalizability of findings, especially in studies with relatively low sample sizes. This does not diminish the value of qualitative data, but future research could incorporate quantitative methodologies and look at different types of research projects to reinforce or build on the results of these studies.

Future Research Directions

As stated above, quantitative methods could be used to strengthen the conclusions reached in this dissertation. It will be important to explore a wide range of research projects on various species and various locales that may use a diverse range of methodologies that either incorporate the public or could possibly have a public involvement component. These future studies could reveal nuances on how these different aspects of projects can influence how successful these projects are at engaging the public. Other research approaches that could provide a deeper understanding of the research projects include long-term studies that investigate whether or not the effects of participation in wildlife science are sustainable long-term and studies that engage with more demographically and culturally diverse groups to understand how different communities perceive and interact with research projects that try to incorporate the public into wildlife research.

Final Thoughts

Humanity is at a critical point in its history where it must understand and take responsibility for its impact on the natural world and the wildlife that inhabit it. This dissertation has sought to demonstrate the potential that wildlife research has as more than just a tool for scientific discovery, but as a way to connect people and wildlife, motivating the public to think more about their environmental impacts. The results of the research that makes up this document testify to this potential, demonstrating how engagement with wildlife species, whether in the classroom or under the supervision of a professional wildlife researcher, can turn the public into well-informed stewards of the natural world.

APPENDICES

APPENDIX A

Semi-structured interview script for the Clemson Barred Owl Project participant study

FOCUSED LIFE HISTORY

Do you have any other experience with owls before participating in the Barred Owl Project?

Have you had any encounters with local wildlife on your property or elsewhere?

Have you participated in any other projects similar to the Clemson Barred Owl Project?

DETAILS OF THE EXPERIENCE

Describe your experience during the Clemson Barred Owl Project.(What stood out to you?)

REFLECTION ON THE MEANING

Do you feel as though participation in the project strengthened your connection with owls or

nature in general?

Do you feel as though participation in the project made you more mindful of your impact on the

environment?

APPENDIX B

Semi-structured interview script for the Marion Clément case study

FOCUSED LIFE HISTORY

What got you involved in wildlife research?

What is your history of connection to wildlife?

What were you doing research-wise before this project and was there any aspect of public

involvement?

What are you doing now professionally?

DETAILS OF THE EXPERIENCE

Can you describe the typical interaction with a property owner from contact to owl release?

How did you come up with the public involvement aspect of the project?

What was your favorite part of the public involvement aspect of the project?

What was the most challenging part of the Clemson Barred Owl Project for you?

Were other members of the public involved or invited to participate in the project besides the

property owners?

What sort of contact have you had with project participants since?

REFLECTION ON THE MEANING

What traits of the project do you believe made it so proficient at forming human-wildlife

connection?

Why do you think that the participants formed such strong connections with the owls because of

the project?

What traits do you think make a good public-wildlife interaction facilitator?

What animals do you think that this sort of public involvement strategy would work well with?

Do you think that participants gained new knowledge or pro-environmental intentions from

being a aprt of this project?

Is there anything else that you think is important about the public involvement aspect of the project that I haven't asked you about yet?

APPENDIX C

Semi-structured interview script for the Trout in the Classroom study

FOCUSED LIFE HISTORY

Do you have prior experience with trout or other wild fish before this class? Please explain if yes.

Do you have any close experiences with local wildlife as a whole? Please explain if yes.

Did you have any experiences with the skills needed to raise and monitor trout before TITC? Please explain if yes.

DETAILS OF THE EXPERIENCE

How was your trout release experience?

What stood out to you about your experience in TITC?

REFLECTION ON THE MEANING

Do you feel more connected to trout or wild fish following your involvement in this project?

Do you feel more connected to the natural world around you after TITC?

If you feel more connected, will this connection lead you to make more pro-environmental choices? Why?

Do you feel as though you'd be more likely to work in a field that deals with fish/wildlife or conservation after your experience in this project? Please explain.

APPENDIX D

Survey Instrument for Trout in the Classroom Students

FOCUSED LIFE HISTORY

Do you have prior experience with trout or other wild fish before this class? Please explain if yes.

Do you have any close experiences with local wildlife as a whole? Please explain if yes.

Did you have any experiences with the skills needed to raise and monitor trout before TITC? Please explain if yes.

DETAILS OF THE EXPERIENCE

How was your trout release experience?

What stood out to you about your experience in TITC?

REFLECTION ON THE MEANING

Do you feel more connected to trout or wild fish following your involvement in this project?

Do you feel more connected to the natural world around you after TITC?

If you feel more connected, will this connection lead you to make more pro-environmental choices? Why?

Do you feel as though you'd be more likely to work in a field that deals with fish/wildlife or conservation after your experience in this project? Please explain.

DEMOGRAPHIC INFORMATION

What is your age?

Please specify your ethnicity.

What gender do you identify as?

Please specify primary language at home.

APPENDIX E

Survey Instrument for Trout in the Classroom Educators

FOCUSED LIFE HISTORY

In what county do you teach Trout in the Classroom?

At what school do you teach trout in the Classroom?

What made you pick up the Trout in the Classroom program? Was it passed down? Did you

reach out? Did Trout in the Classroom reach out?

How many years have you participated in the Trout in the Classroom program?

Do you participate in any other programs like Trout in the Classroom?

Do you yourself have any experience with trout or other wild fish? Elaborate.

DETAILS OF THE EXPERIENCE

What course/courses do you teach Trout in the Classroom in?

Approximately how many students do Trout in the Classroom each semester?

What grade level do you teach Trout in the Classroom?

Is this an honors or advanced placement (AP) level class?

How much extra time does Trout in the Classroom add to your work week?

Do you see apathy (lack of interest or motivation) towards education from your students? Is it

common?

Does your classroom/school have a cell phone policy? How often is it enforced?

REFLECTION ON THE MEANING

How would you characterize Trout in the Classroom's effect on your students? Positive or

negative?

Have you seen or heard anything that indicates that your students feel a connection with the trout

that they are helping to raise?

Have you seen or heard anything that indicates if your students are thinking deeper on environmental issues during and after Trout in the Classroom? (i.e. clean water, habitat health, etc.)

Have you seen or heard anything that indicates that your students see themselves as being involved in science/being scientists?

Is there anything else that you have not mentioned yet that you see from your students participating in Trout in the Classroom?

Do you personally feel a deeper connection with the fish or with nature as a whole following your participation in trout in the classroom?

Do you think more about the environment following your participation in trout in the classroom?

Do you think you may be more likely to make positive environmental choices?

APPENDIX F

Clemson Barred Owl Project Participant Contributed Photographs