

THESIS

EVALUATING THE ROLE OF CITIZEN SCIENCE IN THE CONTEXT OF HUMAN-
WILDLIFE CONFLICT MANAGEMENT

Submitted by

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ABSTRACT

EVALUATING THE ROLE OF CITIZEN SCIENCE IN THE CONTEXT OF HUMAN-WILDLIFE CONFLICT MANAGEMENT

This thesis presents two manuscripts that explored the potential of citizen science programs to be utilized in urban centers that are experiencing heightened rates of human-wildlife conflict (HWC). In particular, we focused on human-coyote conflicts, which are an emerging problem in many cities throughout North America. Recent reports have shown that while coyotes typically pose a minimal threat to people, attacks on humans have recently escalated. Certain traditional methods such as lethal control for dealing with human-coyote conflict, and HWC more broadly, are increasingly considered unacceptable to the public, creating a need for management authorities to consider other alternatives. Citizen science, a method in which members of the public contribute to real-world research studies, is one tool that could be considered, as citizen science is thought to be a valuable mechanism for increasing citizens' knowledge of ecological systems and the scientific process, and engaging them in resource management. The overall purpose of this thesis was to determine the motivations and characteristics of citizen science participants and evaluate if involvement in these programs can in fact lead to desired changes in participant understanding and subsequent behavior, therefore offering a useful approach for assisting with HWC management.

The purpose of the first paper was to evaluate the potential for a citizen science program called Coyote Watch to change participant understanding and subsequent behavior in the context of human-coyote conflict in the Denver Metro Area (DMA) of Colorado. Our first objective was

to assess the effects of the program over time on participants' attitudes, beliefs, behavioral intentions, and knowledge regarding coyotes. Our second objective was to explore the broader impacts of the program, including the extent to which participants used their program education and observation experiences to take action in their communities to prevent and manage conflict with coyotes. Data were collected using a mixed methods approach, including on-site and online surveys and interviews that were administered to new and previously trained volunteers of Coyote Watch. Results indicated that participation in Coyote Watch is positively affecting volunteers in terms of how they relate to and think about coyotes and coyote-related issues in their communities. Qualitative data from open-ended survey questions and interviews corroborated quantitative findings and demonstrated that the program is not only providing participants with enhanced knowledge of coyotes and their ecology, but it is also empowering some of these individuals to take action to prevent and manage conflicts with coyotes.

The second paper focused on understanding the characteristics of citizen science volunteers with the intent of being able to inform the development and marketing of future programs in an HWC context. We had three objectives for this case study investigation: 1) assess volunteers' motivations for joining Coyote Watch and subsequently determine whether these motivations were similar to or different from those identified by previous research on volunteerism in environmental projects, 2) explore the extent to which volunteers represented the DMA resident population as a whole with respect to key demographic characteristics, and 3) compare Coyote Watch participants to respondents from a larger DMA resident survey in regards to their coyote-related attitudes, beliefs, and behavioral intentions. Data collection was accomplished using on-site and online surveys administered to Coyote Watch volunteers and through mailed and online surveys for the larger DMA study. Results indicated that volunteers

often had more than one motivation for joining the program, such as an enjoyment of wildlife, a desire to participate in research and to inform others people about coyotes and coyote issues, and that they did in fact share some of the demographic characteristics of DMA residents as a whole. However, we also noted certain demographic differences between volunteers and the resident population, particularly with respect to gender, age, and education. Furthermore, results determined that Coyote Watch volunteers differed in some respects from respondents to the larger DMA-wide resident survey in their attitudes, beliefs and behavioral intentions regarding coyotes, as the volunteers had more positive general attitudes regarding coyotes, they were more likely to agree with advantages of having coyotes in their areas, and they were more likely to perform certain actions around their homes in order to reduce conflict with coyotes. As a whole, these studies demonstrated that many individuals who participated in Coyote Watch expressed a better understanding of coyote behavior and an ability to use their education to take measures to prevent and manage conflict. Additionally, these individuals may be similar to other residents in the DMA, but they tend to feel more positively toward coyotes and they are willing to take more steps to decrease negative interactions with coyotes. Thus, our findings suggest that citizen science programs may offer an innovative alternative method to augment traditional forms of HWC mitigation in urban settings.

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I. EVALUATING THE IMPACTS OF COYOTE WATCH: DETERMINING THE POTENTIAL OF CITIZEN SCIENCE PROGRAMS TO CONTRIBUTE TO URBAN WILDLIFE CONFLICT MITIGATION

Introduction

Human-coyote conflicts are an emerging problem in many cities throughout North America. More broadly, human-wildlife conflict (HWC), an increasingly significant concern for conservation globally, occurs when the needs and behaviors of wildlife negatively affect the goals of humans or when the needs of people negatively impede the goals of wildlife (World Parks Congress, 2004). HWC can range in severity from nuisance incidents (e.g., garbage raiding) to wildlife damaging crops to wildlife injuring or killing pets and humans. While there are many reasons for the rise in HWC worldwide, urbanization is an important contributor, and it has been identified as a threat to many mammalian predator species (Riley et al., 2003). Coyotes (*Canis latrans*) are one such species that are increasingly found in urban areas due to human population expansion into wildlife habitat and their highly adaptive nature (White & Gehrt, 2009); coyotes are able to tolerate human presence and take advantage of the density of food sources, both natural and anthropogenic, found in heavily populated areas (Fox, 2006; Gehrt, Anchor, & White, 2009; Grubbs & Krausman, 2009). While coyotes typically pose a minimal threat to people, attacks on humans have recently escalated (Timm, 2006; Timm & Baker, 2007). From 1960 to 2006, there were 142 documented cases of coyote attacks on humans in North America, defined as incidents between coyotes and people resulting in a bite to the victim, and a majority of them involved children. In 30% of these cases, the coyotes were being fed by humans in the area (White & Gehrt, 2009), suggesting that the habituation of coyotes to humans due to intentional or unintentional feeding could be a driving force in the rise in attacks in urban environments. Although there have only been two coyote-caused human fatalities, one in

California in 1981 and one in Nova Scotia in 2009, this increasing trend of attacks is a concern to wildlife management authorities and citizens of many metropolitan areas.

The Denver Metro Area (DMA) in Colorado is one such urban environment that is currently experiencing a rise in human-coyote conflict. Denver is the 20th largest city in the United States, with a current population of 2.65 million people that has grown 30% since 1990 (U.S. Census Bureau, 2012). Until 2007, there had only been four reported coyote attacks on humans in Colorado history (Timm & Baker, 2007). Then, in 2009, there were three of these incidents in Denver (City & County of Denver, 2010). More recently, there were three coyote attacks on children in Broomfield in 2011 (Steffen & Whaley, 2011) and one attack on a five-year old boy in Boulder in 2013 (Mitchell, 2013). In addition to attacks on people, coyotes in the DMA pose a growing threat to pets. As an example of the magnitude of this situation, from 2003 to 2011, there were 471 reported pet attacks in the area (Poessel et al., 2013).

Traditionally, wildlife agencies have employed a variety of approaches in response to human-coyote conflict (e.g., snares, cage traps, hazing with rubber bullets or fireworks, decoy dogs, poison, denning, shooting; Conner, Ebinger, & Knowlton, 2008; Martinez-Espineira, 2006; Wittman, Vaske, Manfredo, & Zinn, 1998). However, not only are many of these options less feasible in urban settings, but certain techniques, namely lethal removal, are considered increasingly unacceptable to the public in these areas (Martinez-Espineira, 2006; Vaske & Needham, 2007; Wittman et al., 1998). Variation in public support for wildlife management techniques is dependent upon the perceived humaneness of the method being utilized as well as the specific context in which it is applied. Studies have shown, for example, that a majority of citizens would not support lethal action if a coyote is simply being a nuisance (e.g., raiding garbage or causing property damage); however, if a coyote were to attack a pet or child, deadly

force is more acceptable (Koval & Mertig, 2004; Martinez-Espineira, 2006; Vaske & Needham, 2007; Wittman et al., 1998). Amidst declining public support for traditional HWC mitigation strategies, such as lethal control, wildlife management authorities are increasingly faced with the need to consider other alternatives including public outreach mechanisms in urban environments.

One specific alternative being explored consists of citizen science programs designed to engage local residents in coyote-related research and management as a way of addressing the human behavior component of HWC and empowering participants to take part in local wildlife conservation efforts. Citizen science is a method that relies on volunteers to collect data for research investigations (Couvet, Jiguet, Julliard, Levrel, & Teysseire, 2008; Silvertown, 2009; Weckel, Mack, Nagy, Roderick, & Wincorn, 2010). While this technique has traditionally been used heavily in ornithological studies (Cohn, 2008; Silvertown, 2009), it has also started to gain traction in HWC situations, including those involving coyotes, as a way to identify potential “hot spots” of conflict by asking citizens to report their experiences and encounters with wildlife (Weckel et al., 2010). One well-recognized benefit of citizen science is that it can be a cost-effective way to collect large amounts of data for projects requiring widespread observations. It has also recently been recognized as a valuable tool for increasing citizens’ knowledge of ecological systems and the scientific process and engaging them in resource management (Brossard, Lewenstein, & Bonney, 2005; Conrad & Hickey, 2011; Evans et al., 2005; Jordan, Gray, Howe, Brooks, & Ehrenfeld, 2011; Trumbull, Bonney, Bascom, & Cabal, 2000). These qualities have resulted in greater attention to the application of citizen science in conservation.

A primary reason for considering citizen science more specifically in the context of human-coyote conflict is that, in addition to facilitating collection of data, it has the potential to increase the public’s understanding of coyotes and coyote-related issues. By teaching local

residents about coyote ecology and behavior and involving them in conflict mitigation, citizen science programs may increase the capacity for communities to deal with conflict situations in the future. Previous research has found that negative attitudes toward wildlife species, such as coyotes, may be attributed in part to a lack of knowledge, awareness, and experience – factors believed to be at the root of human-coyote conflict in urban areas (Baker & Timm, 1998; Hudenko, Decker, & Siemer, 2008). As very few citizen science programs have been formally evaluated, there is a need to determine whether these programs can in fact lead to desired changes in participant understanding and subsequent behavior and therefore serve as a useful tool for HWC management.

Our study was designed to address this need by exploring the potential for a citizen science program called Coyote Watch to contribute to human-coyote conflict mitigation in the DMA. Our first objective was to assess the effects of the program over time on participants' attitudes, beliefs, behavioral intentions, and knowledge regarding coyotes. Our second objective was to explore the broader impacts of the program, including the extent to which participants used their program education and observation experiences to take action in their communities to prevent and manage conflict with coyotes. If programs such as Coyote Watch can be proven effective in contributing to greater awareness, more positive attitudes, and engagement in conflict-reducing behaviors among participants, then this research would serve to inform future decisions about the use of these programs to help address human-coyote conflict in the DMA, as well as other urban communities with emerging coyote-related concerns.

Methods

Program Description

Coyote Watch is a citizen science program that provides educational opportunities with the express purpose of increasing citizens' knowledge and understanding of coyotes and coyote-related issues to help reduce conflict between people and coyotes (M.A. Bonnell, personal communication, 2012). This program was formed in January 2012 by the City of Aurora's Open Space and Natural Resources Division, and since that time, in an effort to have a more widespread impact, it has been offered not only in Aurora, but in other communities throughout the DMA, including the City of Broomfield and Jefferson County. As of May 2013, the program has trained over 300 residents and government officials.

Primary objectives of Coyote Watch are to educate volunteers about the biology and behavior of coyotes in relation to human activity in the DMA, collect coyote behavior observation reports to determine which areas in the community might be at greater risk for negative interactions with coyotes, and reduce biased incident reporting. Biased reporting occurs when residents or the media only report certain types of incidents, for instance human and pet attacks, rather than accounting for the full array of experiences including sightings and behaviors tied to the ecological services coyotes provide (e.g., rodent control). This phenomenon can lead to a distortion in public perceptions of coyotes (M.A. Bonnell, personal communication, 2013).

Prior to participation in the program, volunteers complete a training session consisting of a three hour presentation on: 1) program purpose and objectives; 2) previous research on the actual frequency of conflict incidents (e.g., pet and human attacks) in relation to other coyote-related interactions (e.g., foraging, sightings); 3) basic coyote ecology and behavior; 4) conflict-inducing human behaviors, such as food conditioning; and 5) steps that can be taken to prevent

and mitigate conflict, including hazing techniques. As part of the training, volunteers are shown examples of behaviors that urban coyotes exhibit, as captured on camera, with detailed explanations of the activities. The session ends with the volunteers practicing how to identify these different behaviors (e.g., feeding, yip-howling, den-guarding) and to look for visual and auditory clues to accurately report sightings and behavioral observations using the Coyote Watch report form (see Appendix I).

Sampling and Data Collection

Our study population consisted of two groups of Coyote Watch volunteers: 1) new volunteers; and 2) all remaining volunteers who had been previously trained. Data collection for program evaluation was accomplished using a mixed methods approach, including on-site and online surveys and interviews (see Appendix II for instruments used). First, new volunteers were given a pre-program survey, which was administered on-site during program training sessions, before the beginning of the presentation, in February and March 2013. This survey was intended to assess participants' attitudes, beliefs, behavioral intentions, and knowledge prior to completing the training. Then, an online survey was administered in August 2013 to all individuals who completed the pre-program survey. Volunteers received an initial email containing a link to the survey, followed by weekly reminders for one month. Tied to our first objective for the study, this survey replicated questions from the pre-program survey to facilitate comparisons across time. The online survey was also administered in a similar fashion to the previously trained group of volunteers in May 2013, which provided a larger pool of participants from which to generalize about program impacts.

To address our second research objective and to gain a more complete understanding of program impacts, the online survey sent to both groups also contained open-ended questions

asking volunteers to indicate what they had gained or learned as a result of participating in Coyote Watch. Finally, with these same objectives in mind, we interviewed a subset of individuals from both groups, including previously trained volunteers (Fall 2012) and new volunteers (Spring 2013), to learn more about their program-related experiences and how the program may have influenced them. Our approach consisted of standardized open-ended interviews (Patton, 2002; Tashakkori & Teddlie, 2003) that relied on an interview protocol, but were conducted in a forum that allowed for flexibility in question sequence and inclusion of additional probing questions for further detail. Interviews were conducted in person at meeting places chosen by participants and in some cases (six of the 10 interviews) were administered in pairs with volunteers who requested this arrangement given that they regularly participate in program activities with their partners (Siedman, 2006). Interviews were recorded with volunteers' permission and lasted approximately 20 to 60 minutes each.

Measurement of Key Concepts

Attitudes. Attitudes are evaluations of specific issues or objects that form the basis for human behavior (Ajzen & Fishbein, 1980; Manfreda, Teel, & Bright, 2004). General attitudes toward coyotes were measured on the on-site and online surveys by asking, "Overall, do you think having coyotes in the area near your home is good, bad, or neither?" Responses were recorded on a scale from 1 "extremely bad" to 7 "extremely good". Attitudes toward management strategies for dealing with negative human-coyote interactions were measured on a 7-point scale from "highly unacceptable" to "highly acceptable". Management actions included "leave the coyote alone/monitor the situation", "frighten or haze the coyote away", "capture and relocate the coyote to another area", "lethally remove the coyote" "lethally remove all coyotes

found in the area”, and “provide education for local residents about how to deal with coyotes near their homes”.

Beliefs. According to attitude theory, beliefs are the mental cognitions which form the foundation for attitudes and represent perceptions about outcomes of a given issue or behavior (Ajzen & Fishbein, 1980; Manfredo et al., 2004). Beliefs were measured using a set of 12 statements intended to represent advantages and disadvantages of having coyotes present in the area near one’s residence (Table 1.1). Development of these statements was informed by a phone elicitation to identify salient beliefs about coyotes that was conducted with a small random sample ($n = 25$) of DMA residents for a related study in October 2012 (see Don Carlos et al., unpublished data). Respondents indicated their level of agreement with each statement on a scale from 1 “strongly disagree” to 7 “strongly agree”.

Behavioral intentions. Behavioral intentions are a measure of a person’s willingness to perform a particular behavior and are considered to be the immediate antecedent to behavior (Ajzen, 1991). Behavioral intentions were measured by asking respondents to indicate how likely they were to participate in certain activities that minimize the risk of negative interactions with coyotes. Activities included supervising pets when outdoors, storing garbage or pet food indoors or in a garage/shed, hazing coyotes seen near their homes, and alerting local authorities about coyotes seen near their homes. Responses were recorded on a scale from 1 “very unlikely” to 5 “very likely”.

Knowledge. We used seven true/false questions to measure knowledge about coyotes and coyote behavior (Table 1.2). Respondents were asked to indicate the accuracy of statements such as “coyotes are only active at night” and “coyotes are strict carnivores” by choosing “true”,

“false” or “not sure”. These statements were developed using educational materials presented at Coyote Watch trainings that are aimed at dispelling myths about coyotes in urban settings.

Broader impacts. To explore additional outcomes that may have resulted from program participation, the online surveys asked volunteers in an open-ended format to “indicate one thing you feel you’ve gained or learned as a result of participating in the Coyote Watch Program”.

Additionally, interview participants were asked the following questions:

1. Can you tell me about any experiences you’ve had since joining the program?
2. Are there things you feel you’ve learned as a result of participating in the program?
3. Do you feel that the program has had an impact on you, and if so, how?
 - a. Do you feel it’s affected any of your habits or behaviors? (if yes, explain)
 - b. Since joining the program, have you discussed coyotes or coyote issues with other individuals (if yes, approximately how many)?

Further questions regarding program-related experiences and impacts arose in some cases organically, as many of the participants were eager to share stories about unique interactions with coyotes or conversations they had with non-participants during their volunteer observation outings.

Data Analysis

Quantitative. Survey responses were entered and analyzed in SPSS v. 21 (SPSS Inc., 2012). Paired samples *t*-tests were conducted to compare responses between pre-program and online surveys on attitude, belief, and behavioral intention measures. Exploratory Factor Analysis (EFA) of belief statements was conducted initially in an attempt to reduce the number of variables into logical groups; however, because none of the item groupings met the criteria of having Eigenvalues of at least one and factor loadings greater than .40, we chose to use each

belief statement individually in subsequent analyses. We recognize this as one of the possible limitations of the small sample size of this study.

Responses to knowledge items were coded as 1 “correct” or 0 “incorrect” and summarized using an additive index to formulate an overall knowledge score for each participant. Individuals who responded that they were “not sure” about the accuracy of the statement were given a score of zero for that item. Paired samples *t*-tests were used to compare overall and individual-item knowledge scores across pre-program and online surveys. An alpha level of $p < .05$ was used to designate statistical significance for quantitative analyses, and effect size measures (Cohen’s *d*) were computed to determine practical significance of findings. We used accepted criteria (Cohen, 1988; Vaske 2008) to determine small, medium, and large effects ($d > .20, .50, .80$).

Qualitative. Responses to open-ended survey questions and interviews were coded using open, axial, and selective coding techniques to determine major thematic categories (Neuman, 2006). First, responses were analyzed for broad themes and condensed into coded categories (e.g., “conflict”). Next, the resulting codes were applied to identify subcategories within the themes. For example, the theme “conflict” was separated into three subcategories: understanding root causes of conflict, learning new tools to handle conflict, and using new skills from the program to prevent conflict with coyotes. Finally, codes were examined, organized, and combined into broad categories to develop a conceptual framework recounting the overall narrative of the volunteers regarding impacts the program has had on them (Neuman, 2006). In this last stage, 12 major themes were divided into two generalizations about program impacts, presented in more detail in the results section below. Triangulation of the data was achieved by using multiple data sources (i.e., open-ended survey and interview responses; Olsen, 2004).

Results

Eighty-one new volunteers joined Coyote Watch in February ($n=40$) and March ($n=41$) 2013. Seventy-one of these individuals completed the on-site survey (88% response rate), and 34 also completed the online post-program survey (51% response rate). Additionally, 67 of the 128 previously trained volunteers completed the online survey, resulting in a 52% response rate. Two surveys in this group, and one survey in the new volunteer group, were eliminated due to missing data. Ten volunteers participated in the interviews: two individuals and one couple from the new volunteer group, and two individuals and two couples from the previously trained group.

Comparison of Pre and Post-Participation Responses

Attitudes. The paired t -test analysis revealed that volunteers' attitudes toward coyotes before participation in Coyote Watch ($M = 5.03$) and after participation ($M = 5.30$) were not statistically different ($t(32) = 1.47, p = .15, d = .18$). Approximately 70% of respondents felt that having coyotes in the area near their home was a good thing, even before joining the program. In contrast, volunteers' attitudes toward certain management strategies for dealing with negative human-coyote interactions did significantly change as a result of program participation (Table 1.3). Actions that became more acceptable included: "leave the coyote alone/monitor the situation", "frighten or haze the coyote away", and "provide education for local residents about how to deal with coyotes near their homes". Results indicated a decrease in acceptability for "capture and relocate the coyote to another area". The effect sizes (i.e., strength of association) for these relationships suggested a medium level of practical significance of findings. There were no significant differences between pre- and post-program responses for the acceptability of "lethally remove the coyote" and "lethally remove all coyotes found in the area". Regardless of

participation, volunteers generally did not support lethal control of coyotes; 81% and 93% of participants were against these measures before joining the program.

Beliefs. For most belief statements regarding the advantages and disadvantages of having coyotes in the area near one's home, volunteers' pre- and post-participation scores were not significantly different (Table 1.1). However, differences were found for statements representing the threats coyotes may pose to children and pets in local areas; participation in Coyote Watch contributed to a reduced level of concern for these potential risks. To illustrate, 30% of volunteers indicated that they were concerned about the risks that coyotes pose to children before the program, but only 18% were concerned afterwards. Likewise, 83% of volunteers agreed initially that coyotes pose a threat to the safety of pets, but after joining Coyote Watch that percentage was reduced to 71%. The effect sizes for these relationships were relatively small, suggesting a weaker association between participation and beliefs centered around concern for pets and children.

Behavioral Intentions. Analysis determined that volunteers were not more likely as a result of program participation to store garbage indoors, store pet food indoors, supervise pets when outdoors, or alert local authorities about coyotes seen near their homes to minimize the risk of negative interactions with coyotes (Table 1.4). With the exception of alerting local authorities about the presence of coyotes (where 79% were unlikely), a relatively high percentage of respondents (76-94%) reported they were already likely to engage in these activities prior to the program. Volunteers did indicate, however, a greater likelihood of hazing coyotes seen near their homes after participating (72%), compared to before the program (82%). The effect size for this relationship was $d = .37$, implying a small to medium association between participation and this behavioral intention indicator.

Knowledge. In general, volunteers were fairly knowledgeable about coyotes before beginning the program (Table 1.2). Nevertheless, results did find that there were significant differences between overall pre- ($M = 0.71$) and post-participation ($M = 0.82$) knowledge scores ($t(32) = 3.06, p = .009, d = .64$). The effect size for this comparison suggested a moderate degree of association between participation and knowledge. More specifically, individual-item comparisons indicated a higher likelihood of correct scoring following program participation for the statement, “In urbanized environments, coyotes spend the majority of their time in undeveloped areas”. Before the program, only 32% of respondents correctly answered this question, but after participation 64% of respondents answered accurately. Similarly, differences were noted for the statement, “A coyote following a human while walking a dog is considered to be an aggressive act”, where respondents were correct 36% of the time before the program and 61% after participation. Pre- and post-participation comparisons for the remaining five knowledge items were not statistically significant.

Exploring the Broader Impacts of Coyote Watch

Analysis of the qualitative data from open-ended survey questions and interviews revealed two broad generalizations about program impacts: 1) Coyote Watch *precipitates a new knowledge* of coyotes and human-coyote interactions, and 2) the program *creates empowerment* among its volunteers. These two basic themes are discussed in more depth below and supported by specific quotes from volunteers. All quotes are verbatim, and only minor edits were made to correct grammatical errors and typos. To ensure confidentiality, survey participants were assigned a random identification number corresponding to the group of volunteers to which they belonged: new volunteers who attended the February 2013 training of Coyote Watch (1001-2021), new volunteers who attended the March 2013 training (3000-3038), and previously

trained volunteers (4001-4145). Additionally, the names of interview participants were replaced by alias initials.

Precipitates a new knowledge. Results revealed that nearly all of the volunteers acquired a new understanding of coyotes and coyote-related issues. While some volunteers recalled specific information they had obtained about coyotes, such as diet and behavior, many others explained they had achieved a deeper meaning from the education provided by Coyote Watch. The sample quotes below demonstrate the range of knowledge that volunteers gained as a result of participation.

Many volunteers simply reported that they learned a lot about coyote biology and behavior:

4030: "I've learned that coyotes are very tolerant of us humans. They are still pretty wary, but will put up with, and live with, a lot of different human activities."

4042: "Their main diet is not cats and Chihuahuas. Really! I didn't know that [they eat] wild fruits."

4142: "I loved the meeting and learned great info about how coyotes think and act. [I've learned] what body language means and how things weren't as they are portrayed in the media."

4090: "I found out that coyotes move around, probably for better food and shelter. I did find out that if you leave them alone they will leave you alone. I have a large dog so I do know that helps."

Further, some participants indicated that Coyote Watch taught them about how human behaviors play a role in driving negative interactions with coyotes:

3006: "It is mostly our (people's) fault that has resulted in encounters not favorable to either species."

4068: "Many people are misinformed about the behavior of coyotes."

4001: "People still ignore warnings about coyotes and let their pets out unsupervised."

Participants also explained that the program has impacted the way they view coyotes, and they are now looking at the species in a new positive light:

KN: "I have seen some coyote behavior that I had not viewed before - e.g., barking, woofing, howling. This was very exciting. The coyotes I have viewed have been very

respectful of humans. I do not have much fear of them (perhaps that is not a good thing). To watch how they protect their pups has been heartwarming.”

1004: “Coyotes are not as big a threat as I originally assumed them to be, and I respect their boundaries more.”

3031: “[I’ve gained] a greater appreciation for the role the coyote plays in our ecosystem.”

DD: “...I am looking at coyotes in a totally different way.”

Impacts on participants were described in some instances as the realization that coyotes and people can inhabit the same places:

4045: “We need coyotes and have to get along with them as they are an important part of the ecosystem.”

4035: “...learned about coyote behavior and the importance of their place in our environment.”

3001: “... Although I see that they could become a problem, I have much more empathy for their situation and want to make sure that if they MUST be destroyed, it is done in a humane way...no leg hold traps, no traps that are not monitored closely and checked frequently.”

SD: “One lady at my HOA (Home Owner’s Association) told the HOA to get rid of them and she pretty much got booted out of the room. They were here first. Live with it.”

Volunteers also recounted how the program has taught them how to reduce the likelihood of negative interactions with coyotes:

4113: “I’ve learned the skills to haze a coyote.”

4006: “I’m more alert to watching for coyotes.”

4092: “I learned to keep my dogs on leash in coyote habitat areas.”

Creates empowerment. In addition to new knowledge about coyotes and coyote-related issues, many volunteers explained that they acquired a sense of power from participating in Coyote Watch. As illustrated by the examples and supporting quotes below, these individuals felt emboldened by the program through its teachings and were more self-assured in being able to address potential conflict situations and educate others in their communities.

First, participation in the program gave many volunteers the confidence to take action and inform others about what to do when dealing with human-coyote interactions in the future:

4029: “Confidence. I took both of my daughters (who were afraid of getting out of the house because of coyotes) to the training program. Since they learned about the coyotes (habitat, habits, hazing techniques, etc.) they are more confident and not as scared.”

3034: “Gained the courage to haze if I ever get the chance.”

2015: “More information and knowledge on coyote behavior. [I’ve gained] the ability to talk to neighbors about them with more confidence and truth.”

4111: “Confidence when telling others about coyotes, and knowing what to do if I see a coyote.”

Another element related to empowerment that volunteers felt they had gained as a result of participation was a stronger tie to their community and a sense of being able to make a difference in that context:

4012: “Feeling a part of my community, part of the solution, and more educated about coyotes in general.”

4108: “It takes a community to learn to live with coyotes successfully.”

3004: “This is a coordinated effort to better understand this species and learned there are new ways to gather information.”

Results also revealed how volunteers were going a step further with the knowledge and greater sense of confidence acquired through the program by taking real action to prevent negative interactions with coyotes.

DD: “I do go out with my dog now and that is something I didn’t do before. I check the yard before she goes out even though she’s a fairly large dog, but I’ve heard stories, so why take the chance?”

WL: “[I] was walking once...and a lady had a little dog off leash. They [the coyotes] had a den nearby, so I yelled at her to call her dog. Sure enough, the dog comes racing back with two coyotes on its tail...I picked up some little rocks and tossed them, which seemed to be enough to make them take off...”

SD: “There are a couple of places along the trail that there is a short chain link fence and people leave their small little yappy dogs out and once I stood between a dog and a coyote because the coyote could go right over the fence...it [the dog] didn’t have enough sense to shut up. It kept barking and barking and the coyote was watching it, waiting.”

Additional impacts of the program resulted from participants disseminating information they obtained to others. A number of participants described how they were not only educating

their neighbors and members of close social networks, but complete strangers they encountered while out making observations for Coyote Watch:

WL: “People will come up and approach us and ask about coyotes... people want information. Mostly these people are pro-coyote; they come to see the animals and enjoy them... One time we saw a woman with a dog off leash [in the park], it was a fairly small dog and the dog was going over to where the coyotes’ den is and a coyote went after the dog. It did not get the dog, but the woman said, ‘I guess I’ve learned my lesson’.”

KN: “We’ve gotten to know the other people who walk in the parks and we talk about what we saw, what the coyotes are doing, and why.”

4101: “We need to learn to live coyotes; I’ve been able to talk to people who are scared of coyotes.”

2022: “Understanding coyote behavior has been a valuable asset when talking to JeffCo [Jefferson County] open space park visitors and neighbors.”

4052: “I pretty much knew next to nothing about coyotes before, so I learned a lot of new information that I can use to teach other people.”

JS: “There’s a lady here on the corner...and she has...coyotes. They actually have beds and food. If you were a coyote, wouldn’t you want to sleep there? I would. They like heated beds. I swear if someone had told me that lady had brought those coyotes in over the winter, I would not be surprised. I’d of been, ‘oh, she’s nuts.’ So of course I had to go over there and give her the what for.”

Discussion

The overarching goal of this study was to explore the potential for citizen science programs to serve as a tool for urban HWC mitigation. Specifically, our research consisted of a mixed-methods approach to evaluation of Coyote Watch, a citizen science program in the DMA. The evaluation was designed to explore broad program impacts as well as specific effects on participants’ coyote-related attitudes, beliefs, behavioral intentions, and knowledge. Results of quantitative surveys administered before and after program participation indicated that Coyote Watch is positively affecting volunteers in terms of how they relate to and think about coyotes and coyote-related issues in their communities. Further, qualitative data from open-ended survey questions and interviews corroborated quantitative findings and demonstrated that the program is not only providing participants with enhanced knowledge of coyotes and their ecology, but it is

also empowering some of these individuals to take action to prevent and manage conflicts with coyotes.

Past research on citizen science has been primarily focused on understanding the benefits of this approach to scientific inquiry, such as lower research costs and the ability to collect data over vast areas of space and time. It is only in the last decade that researchers have become interested in how involvement in citizen science may impact the volunteers themselves. One area of interest is in determining if these individuals are becoming more knowledgeable about science and conservation issues. Though previous literature has claimed that participation in citizen science increases volunteers' knowledge, very few organizations have formally evaluated their programs to test for this outcome (Brossard et al., 2005; Evans et al., 2005; Jordan et al., 2011; Turnbull et al., 2005). While our results showed that Coyote Watch volunteers were already fairly knowledgeable about coyote ecology and behavior before joining the program, findings also demonstrated that participants gained new information and new perspectives as a result of participation. Overall knowledge scores increased, and training received through Coyote Watch also impacted participant beliefs, resulting in a decreased level of concern regarding the potential threats that coyotes may pose to children and pets, showing the potential for this type of program to address misperceptions of risk.

Another aspect of citizen science that has had very little attention in prior research is the impact of the program on participant attitudes. A study done by Brossard and colleagues (2005) determined that volunteers did not significantly change their attitudes toward the environment. Yet, as was the case for Coyote Watch participants, these volunteers already reported having positive attitudes regarding the subject matter before the program. It is also worth noting that our study, and that of Brossard et al., had a small sample size, limiting our ability to find statistical

significance for minor changes that may have occurred. Future quantitative research evaluating the impacts of conservation-oriented citizen science initiatives on volunteers' attitudes could benefit from having a larger pool of participants. On the other hand, participant attitudes toward management actions designed to handle negative interactions with coyotes did change as a result of the Coyote Watch program. One of the lessons taught in Coyote Watch is that relocating coyotes is against state wildlife agency policy, and hazing is an effective way to reduce negative interactions with coyotes; accordingly, results showed a decrease in the acceptability of relocation and increased support for hazing following participation. In contrast, volunteers' attitudes regarding lethal control of coyotes did not change; both before and after the program, a majority of participants opposed the use of this strategy. Past research has shown that increasing urbanization has led to a shift in the way residents view wildlife (Manfredo, Teel, & Henry, 2009) and that traditional forms of management are increasingly unacceptable to urban publics (Martinez-Espineira, 2006). A study conducted by Vaske and Needham (2007) found that DMA residents tend to have more protectionist views toward wildlife, and lethal control techniques are, as a result, not universally supported; our findings tend to mirror this sentiment.

Our study goes beyond simply a focus on knowledge and attitudes to understand if citizen science can affect human behaviors that often underlie the cause as well as the solution to today's conservation problems, including HWC. In many HWC situations, public education programs are a recommended management strategy (Gehrt, 2006; Fox, 2006; Lukasik & Alexander, 2011; Timm, 2006); yet, there is little evidence to suggest that these types of programs, which often center around raising awareness and knowledge through information provision, are accomplishing their goals and contributing to a decrease in the number of negative human-wildlife interactions. Currently, throughout North America, there are approximately half

a dozen large urban coyote monitoring programs employing various educational strategies to engage the public in conflict management. These initiatives range from a simple online reporting system of coyote sightings to more integrated programs with extensive educational curricula. For example, programs in Niagara Falls and Calgary have online coyote sighting reporting systems for the public, while Coyote Watch Canada in Ontario and Project Coyote in California concentrate on offering educational programs for the public. Programs in Vancouver and Edmonton offer both a mapping tool and public education. However, none of these programs are providing an educational outreach program to volunteers that trains them to collect data on coyote behavior for research purposes in addition to teaching them how to reduce conflict around their own homes. For these programs to have the same kinds of impacts that we have found in Coyote Watch, we recommend that they include an educational component with formalized training about how to accurately report coyote behavior and address negative human-coyote interactions in local communities. We also recommend that these programs include an evaluative component to be able to document immediate and long-term impacts.

If programs such as Coyote Watch are to be considered useful tools for wildlife managers in the future, scientific evidence must show that volunteers are making a difference on the ground and that these programs are actually contributing to a reduction in urban wildlife conflict. Consistent with this desired outcome, results of our qualitative and quantitative analyses revealed that, in addition to imparting information that affected participants' knowledge and beliefs about coyotes, Coyote Watch facilitated adoption of behaviors such as hazing that can actively reduce the likelihood of negative human-coyote interactions. Not only did volunteers indicate a greater likelihood of administering hazing techniques themselves to minimize the risk of negative interactions around their homes after participation, they detailed how they are using their

education to take action. The program also gave volunteers greater confidence and a sense of duty to communicate with others about these issues, thus helping to strengthen community capacity for addressing conflict situations. Lessons learned from this investigation suggest that Coyote Watch may serve as a model to help other educational programs focused on HWC issues gauge the success of their efforts and ultimately improve their effectiveness on the ground.

The increase in frequency of coyote attacks on humans in the DMA emphasizes the need to better understand the coyote populations that inhabit this urban landscape, as well as the human behavioral component. Also needed is additional research on the reach and effectiveness of citizen science and other educational initiatives that can play a role in addressing this situation. As an example, one way to increase the level of engagement and retain citizen science volunteers long-term is to provide feedback in the form of press releases, newsletters, and even incentives and challenges (Dickinson et al., 2012). As Coyote Watch does not currently provide these methods of follow-up, it would be useful to research whether this added feedback could create a stronger sense of community among participants and increase the number of volunteers who take action to prevent conflicts with coyotes in their neighborhoods. Future research stemming from this investigation could also explore how participation in programs such as Coyote Watch might impact individuals who live in areas with a high incidence of coyote activity, but who do not have positive attitudes toward the species prior to involvement. It would be useful, for example, to understand the impacts this type of program might have in an area like Nova Scotia that is more rural and has experienced a human fatality as a result a coyote attack, unlike the DMA. Another avenue for possible expansion on this study would be to follow up with Coyote Watch participants at a later date to see if their actions learned through the program have continued and are resulting in an actual decrease in negative human-coyote interactions in

their communities; researching not only the retention rates and continued activities of Coyote Watch volunteers, but also whether the rates of conflict incidents in their neighborhoods change as a result of the program would lead to a better understanding of on-the-ground impacts long-term. Finally, future research could benefit from a further examination of the characteristics of HWC citizen science program volunteers, including their motivations for involvement and the extent to which they represent the broader populations (e.g., DMA residents as a whole) to which they belong. This latter recommendation, which could help improve the targeting and reach of future programs, was the impetus for another investigation we conducted with Coyote Watch participants, the results of which are detailed in Chapter Two of this thesis.

Many individuals who participated in Coyote Watch expressed a new found ability to deal with human-coyote conflict themselves through a better understanding of coyote behavior and steps that can be taken to prevent and manage conflict incidents. This study showed that, not only are residents interested in getting involved in local coyote management, but many now feel empowered as a result of the program to use their knowledge to affect change and inform others about how to do the same. As whole, our results suggest that citizen science programs may offer an innovative alternative or complement to traditional forms of HWC mitigation in urban settings, and we recommend continued research in this area to evaluate the full potential of these programs for use in different geographic locations.

Table 1.1 Comparison of participants' responses to belief statements pre- and post-program.

Beliefs ¹	Participation in Coyote Watch		<i>t</i> -value	<i>p</i> -value	<i>d</i>
	Pre-program	Post-program			
I enjoy seeing coyotes in the area near my home	5.48	5.82	1.10	.28	.21
I enjoy knowing coyotes are in the area near my home even if I never see one.	5.27	5.70	1.70	.10	.24
Coyotes pose a threat to the safety of children in the area near my home.	3.27	2.64	2.72	.01*	.39
Coyotes pose a threat to the safety of pets in the area near my home.	5.36	4.82	2.12	.04*	.42
Coyotes help control populations of rabbits and other small animals in the area near my home	6.33	5.91	1.75	.09	.35
There are no benefits to having coyotes in the area near my home.	1.97	1.91	0.67	.51	.12
Coyotes are important to the natural ecosystem in the area near my home.	6.21	6.55	1.54	.13	.29
Having coyotes in the area near my home is an inconvenience	2.72	2.52	0.80	.43	.11
I'm concerned about risks posed by having coyotes in the area near my home.	3.15	2.52	1.76	.09	.32
Learning how to co-exist with coyotes is a normal part of living here.	6.51	6.64	0.85	.40	.13
Coyotes do not belong in the area near my home.	1.78	2.06	0.89	.38	.18
I shouldn't have to change what I do in the area near my home because coyotes are present	2.24	2.24	0.0	1.0	.00

1. Items measured on a scale from 1="strongly disagree" to 7="strongly agree".

2. Effect sizes were calculated using Cohen's *d*. Indices of .20, .50 and .80 indicate small, medium, and large effects.

* Results are significant at a *p* < .05 level.

Table 1.2 Comparison of participants' responses to knowledge questions pre- and post-program.

Knowledge Scores ¹	Participation in Coyote Watch		<i>t</i> -value	<i>p</i> -value	<i>d</i>
	Pre-program	Post-program			
In residential neighborhoods, coyotes' primary food is domestic pets. (False)	0.90	0.94	0.44	.66	.12
In urbanized environments, coyotes spend the majority of their time in undeveloped areas. (True)	0.32	0.61	2.75	.01*	.60
Coyotes are strict carnivores (only eat meat). (False)	0.87	0.87	0.0	1.0	.00
Relocating coyotes is the most effective and humane way to resolve coyote conflict with people in the Denver Metro Area. (False)	0.68	0.74	0.70	.49	.14
In areas where coyotes live in close proximity to humans, coyote attacks on humans are rare. (True)	0.90	0.97	1.44	.16	.46
A coyote following a human while walking a dog is considered to be an aggressive act. (False)	0.35	0.58	2.04	.05*	.46
Coyotes are only active at night. (False)	0.90	1.00	1.79	.08	.46

1. Items computed by coding responses into "correct"=1 and "incorrect"=0. Individuals who responded that they were "not sure" about the accuracy of the statement were given a score of zero for that item.
2. Effect sizes were calculated using Cohen's *d*. Indices of .20, .50 and .80 indicate small, medium, and large effects.
3. Results are significant at a $p < .05$ level.

Table 1.3 Comparison of participants' attitudes toward management actions pre- and post-program.

Attitudes ¹	Participation in Coyote Watch		<i>t</i> -value	<i>p</i> -value	<i>d</i>
	Pre-program	Post-program			
Leave the coyote alone/monitor the situation	5.52	6.27	2.11	.04*	.47
Frighten or "haze" the coyote away	5.90	6.67	2.97	.006*	.70
Capture and relocate the coyote to another area	3.94	3.15	2.22	.03*	.44
Lethally remove the coyote	2.26	2.15	0.85	.40	.12
Lethally remove all coyotes found in the area	1.43	1.39	0.00	1.0	.00
Provide education for local residents about how to deal with coyotes near their homes	6.77	6.97	2.68	.01*	.60

1. Items measured on a scale from 1= "highly unacceptable" to 7= "highly acceptable".
 2. Effect sizes were calculated using Cohen's *d*. Indices of .20, .50 and .80 indicate small, medium, and large effects.
- Results are significant at a $p < .05$ level.

Table 1.4 Comparison of participants' behavioral intentions pre- and post-program.

Behavioral Intentions ¹	Participation in Coyote Watch		<i>t</i> -value	<i>p</i> -value	<i>d</i>
	Pre-program	Post-program			
I am likely to store garbage indoors or in a garage/shed	4.18	4.36	0.73	.47	.13
I am likely to store pet foods indoors or in a garage/shed	4.72	4.79	0.26	.80	.07
I am likely to supervise pets when they are outdoors	4.31	4.64	1.53	.14	.20
I am likely to frighten or “haze” way a coyote that is near my home	3.94	4.39	2.33	.03*	.37
I am likely to alert local authorities if I see a coyote near my home	1.73	1.94	0.91	.37	.18

1. Items measured on a scale from 1= “very unlikely” to 5= “very unlikely”.
 2. Effect sizes were calculated using Cohen’s *d*. Indices of .20, .50 and .80 indicate small, medium, and large effects.
- Results are significant at a $p < .05$ level.

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II. MOTIVATIONS AND CHARACTERISTICS OF URBAN CITIZEN SCIENCE VOLUNTEERS: A CASE STUDY INVOLVING HUMAN-COYOTE CONFLICT

Introduction

Citizen science has been emerging recently as an innovative tool that involves the public in research designed to address the ecological concerns of the 21st century. Increased attention to this approach has arisen in the form of publications and journal special issues, conference sessions, and large-scale internet-based collaborative projects with volunteers and research scientists. For example, a search for the term “citizen science” in Web of Science revealed only 19 scientific articles published on the subject from 1950 to 1990 (Lepczyk et al., 2009), but from 1990 to 2013 there were over 2,000 papers on the topic. At the 2008 Ecological Society of America conference, over 60 presented papers discussed citizen science (Silvertown, 2009). Worldwide, there are hundreds of thousands of citizen science volunteers contributing to research, on topics ranging from astronomy to zoology. To illustrate, two of the largest citizen science initiatives, led by The Cornell Lab of Ornithology and Galaxy Zoo, have 200,000 and 180,000 volunteers, respectively (Lepczyk et al., 2009; Raddick et al., 2010). This increasing trend of public engagement in ecological science could prove to have a real impact on the way science is conducted and utilized in the future.

The term “citizen science” can be used to describe a wide range of citizen involvement in scientific pursuits, but in general it is a method in which members of the public contribute to real-world research studies (Couvett, Jiguet, Julliard, Levrel, & Teyssedre, 2008; Lepczyk et al., 2009; Wiggins & Crowston, 2011). The fields of ornithology and astronomy have been using this approach for centuries (Dickinson, Zuckerberg, & Bonter, 2010; Cohn, 2008; Silvertown, 2009); however, citizen science is now utilized in studies on an array of issues, including weather and

climate change, invasive species, habitat management, and the ecological monitoring of taxa, from fungi to mammals (Dickinson et al., 2010; Silvertown, 2009).

Historically, the biggest benefit of citizen science has been the ability to collect a large amount of data for projects requiring widespread observations (Conrad & Hickey, 2011; Whitelaw, Vaughan, Craig, & Atkinson, 2003). While some scientists may argue that data collected by non-researchers are sub-par, recent studies have found that information collected by citizens is comparable to that gathered by experts (Engel & Voshell, 2002; Galloway, Tudor, & Vander Haegen, 2006; Oscarson & Calhoun, 2007; Delaney, Sperling, Adams, & Leung, 2008). Citizen science has also been recognized more recently as a valuable tool for increasing citizens' knowledge of ecological systems and the scientific process, and engaging them in resource management (Brossard, Lewenstein, & Bonney, 2005; Conrad & Hickey, 2011; Evans et al., 2005; Jordan, Gray, Howe, Brooks, & Ehrenfeld, 2011; Trumbull, Bonney, Bascom, & Cabal, 2000; Trumbull, Bonney, & Grudens-Schuck, 2005; Weber, 2000). These qualities have resulted in greater attention to the application of citizen science in conservation.

One area of study that has the potential to capitalize on the benefits of citizen science is human-wildlife conflict (HWC). HWC occurs when the needs and behaviors of wildlife species negatively affect the goals of humans or when the needs of people negatively impede the goals of wildlife (World Parks Congress, 2004). In urban environments, conflicts can range from nuisance incidents (e.g., garbage raiding) to wildlife damaging crops to wildlife injuring or killing pets and humans. Citizen science as a technique has several specific advantages that could be useful for collecting data about HWC in urban settings and effectively addressing these types of situations. First, wildlife managers are often extremely limited in their research budget, and citizen science can be a cost effective method of gathering data across a large geographic area of

interest (Asah & Blahna, 2012; Cohn, 2008; Silvertown, 2009; Whitelaw et al., 2003). Second, as HWC occurs on private as well as public lands, residents have access to and the ability to monitor property that is typically off limits to researchers (Colding, Lundberg, & Folke, 2006; Lepczyk, Mertig, & Lui, 2004), which can lead to a better understanding of the causes and occurrence of conflicts as a whole. Third, including the public in the scientific process may offer an effective and easy way to educate them about wildlife issues (Evans et al., 2005). Finally, this method may help lessen the knowledge gap between experts and laypersons, and could result in local residents becoming more involved in and accepting of management decisions (Calhoun & Reilly, 2008; Weckel, Mack, Nagy, Roderick, & Wincorn, 2010).

Citizen science is starting to be used in the HWC context to help identify “hot spots” of potential conflict (Weckel et al., 2010); however, this approach could also be considered as a means of reducing HWC by educating citizens about how to prevent and manage human-wildlife interactions in their communities. Research is needed to determine if such additional outcomes of citizen science programs are possible in cities that are currently experiencing a heightened incidence of HWC and also to better understand the characteristics of program volunteers, including their motivations for becoming involved, to determine if there is enough of a demand to affect change. By identifying which segments of the public are most interested in contributing to HWC research and mitigation, and also which groups may be underrepresented in current programs, wildlife managers may be in a better position to determine as well as improve the reach and effectiveness of citizen science programs as a tool for addressing HWC problems in the future.

Prior Research on the Motivations and Characteristics of Citizen Science Volunteers

There is an extensive body of literature on volunteer motivations, but few studies have examined citizen science volunteers specifically (Nov, Arazy, & Anderson, 2011; Raddick et al., 2010). Previous research on the latter has shown that motivations are often specific to the subject matter of the science being conducted. For example, in studies conducted by Raddick and colleagues (2010; 2013) on the volunteers of Galaxy Zoo, an astronomy citizen science project, primary motivations included vastness (“I am amazed by the vast scale of the universe”), discovery (“I can look at galaxies that few people have seen before”), and beauty (“I enjoy looking at the beautiful galaxy images”) (Raddick et al., 2010). Consequently, results of these investigations are not easily extrapolated to other citizen science initiatives. Nonetheless, there are several common thematic categories gleaned from previous motivation studies that can be applied to citizen science. Important reasons for volunteering in environmental projects include: 1) a desire to increase knowledge through participation in the environment or project subject (Measham & Barnett, 2008; Raddick et al., 2010; Ryan et al., 2001); 2) a desire to contribute to one’s community (Asah & Blahna, 2012; Measham & Barnett, 2008); 3) social contact (Gilmour & Saunders, 1995; Measham & Barnett, 2008); and 4) to acquire career-related skills (Asah & Blahna, 2012; Clary & Snyder, 1999; Wearing, 2001).

Demographic characteristics of volunteers have also been examined in the literature, often focusing on gender, income, education, and age. Prior research on volunteers in environmental projects indicates that women are more likely to participate than men (Measham & Barnett, 2008; Trudeau & Devlin, 1996; Yoshioka, Brown, & Ashcraft, 2007); higher education is positively correlated with volunteerism (Measham & Barnett, 2008; Yoshioka et al., 2007); and participants are more likely to be middle aged or of retirement age (Measham &

Barnett, 2008; Wilson, 2000). However, consistent with conclusions drawn from the motivations literature, these trends may vary for citizen science volunteers, depending on the focus of the project. For example, in the Galaxy Zoo studies, more than 80% of volunteers were male, with a mean age of 43 (Raddick et al., 2010). Yet, in a sea turtle citizen science project led by the Florida Fish and Wildlife Conservation Commission, a majority of volunteers were older, educated women, which reflects the findings of the more general volunteer demographics studies (Bradford & Israel, 2004). Due to such variation in findings across projects and the lack of research specific to HWC-related citizen science initiatives, there is a need to better understand the nature of the volunteer audience in this context to inform the development and marketing of future programs.

Study Purpose

The purpose of this study was to examine the characteristics of the volunteers of a citizen science program known as Coyote Watch, which deals specifically with human-coyote conflict in the Denver Metropolitan Area (DMA) of Colorado. We had three primary objectives for this case study investigation. First, we sought to assess volunteers' motivations for joining Coyote Watch and subsequently determine whether these motivations were similar to or different from those identified by previous research. Our second objective was to explore the extent to which volunteers represented the DMA resident population as a whole with respect to key demographic characteristics. For this comparison, we relied on data from a concurrent DMA-wide survey of residents about coyote-related issues (Don Carlos et al., unpublished data). Finally, to more fully explore possible differences and similarities between volunteers and the broader public, we also compared Coyote Watch participants to respondents from the DMA resident survey in regards to their coyote-related attitudes, beliefs, and behavioral intentions.

Methods

Study Site and Program Description

Human-coyote conflict in the DMA. Humans have a long history of conflict with coyotes (*Canis latrans*) in North America. For over 150 years, coyotes have been treated as agricultural pests to be eradicated, as they can pose a serious threat to livestock (Lukasik & Alexander, 2011) and are estimated to cause over \$40 million in damage to U.S. ranchers annually (Conner, Ebinger, & Knowlton, 2008). However, coyotes have also proven themselves to be capable city-dwellers. While the threat to people from urban coyotes is typically minimal, there is evidence of a recent escalation in attacks on humans across the continent (Timm, 2006; Timm & Baker, 2007). From 1960 to 2006, there were 142 documented cases of coyote attacks on humans in North America, defined as incidents between coyotes and people resulting in a bite to the victim, and a majority of them involved children (White & Gehrt, 2009). Although there have only been two coyote-caused human fatalities, one in California in 1981 and one in Nova Scotia in 2009, this increasing trend of attacks is a concern to wildlife management authorities and citizens of many metropolitan areas.

The DMA is one such urban environment that is currently experiencing a rise in human-coyote conflict. Denver is the 20th largest city in the United States, with a current population of 2.65 million people that has grown 30% since 1990 (U.S. Census Bureau, 2012). According to Timm and Baker (2007), there had only been four reported coyote attacks on humans in Colorado prior to 2007. Then, in 2009, there were three of these incidents in Denver (City & County of Denver, 2010). More recently, there were three coyote attacks on children in Broomfield in 2011 (Steffen & Whaley, 2011) and one attack on a five-year old boy in Boulder in 2013 (Mitchell, 2013). There has also been a recent escalation in coyote attacks on pets in the

DMA; from 2003 to 2011, there were 471 reported attacks on domestic animals in the area (Poessel et al., 2013).

The Coyote Watch program. Coyote Watch is a citizen science program that provides educational opportunities with the express purpose of increasing citizens' knowledge and understanding of coyotes and coyote-related issues to help reduce conflict between people and coyotes (M.A. Bonnell, personal communication, 2012). This program was formed in January 2012 by the City of Aurora's Open Space and Natural Resources Division, and since that time, in an effort to have a more widespread impact, it has been offered not only in Aurora, but in other communities throughout the DMA, including the City of Broomfield and Jefferson County. As of May 2013, the program has trained over 300 residents and government officials.

Primary objectives of Coyote Watch are to educate volunteers about the biology and behavior of coyotes in relation to human activity in the DMA, collect coyote behavior observation reports to determine which areas in the community might be at greater risk for negative interactions with coyotes, and reduce biased incident reporting. Biased reporting occurs when residents or the media only report certain types of incidents, for instance human and pet attacks, rather than accounting for the full array of experiences including sightings and behaviors tied to the ecological services coyotes provide (e.g., rodent control). This phenomenon can lead to a distortion in public perceptions of coyotes (M.A. Bonnell, personal communication, 2013).

Prior to participation in the program volunteers complete a training session consisting of a three hour presentation on: 1) program purpose and objectives; 2) previous research on the actual frequency of conflict incidents (e.g., pet and human attacks) in relation to other coyote-related interactions (e.g., foraging, sightings); 3) basic coyote ecology and behavior; 4) conflict-inducing human behaviors, such as food conditioning; and 5) steps that can be taken to prevent

and mitigate conflict, including hazing techniques. As part of the training, volunteers are shown examples of behaviors that urban coyotes exhibit, as captured on camera, with detailed explanations of the activities. The session ends with the volunteers practicing how to identify these different behaviors (e.g., feeding, yip-howling, den-guarding) and to look for visual and auditory clues to accurately report sightings and behavioral observations using the Coyote Watch report form (see Appendix I).

Sampling and Data Collection

Our study population consisted of two groups of Coyote Watch volunteers: 1) new volunteers; and 2) all remaining volunteers who had been previously trained. Data collection involved the use of several different survey methodologies (see Appendix II for instruments used). First, new volunteers were given a pre-program survey, which was administered on-site during program training sessions, before the beginning of the presentation, in February and March 2013. Then, an online survey was administered in May 2013 to previously trained volunteers, who received an initial email containing a link to the survey, followed by weekly reminders for one month. Tied to our first two objectives, both surveys contained questions designed to measure volunteers' motivations and demographic characteristics.

To address our third study objective, the on-site survey also included items intended to assess participants' coyote-related attitudes, beliefs, and behavioral intentions prior to participation in the program. To facilitate comparisons with the broader DMA public, these items were replicated from a larger DMA-wide investigation of residents' experiences with and perceptions about coyotes (Don Carlos et al., unpublished data). Data for this broader investigation, which also allowed for comparisons on key demographic variables, were collected using both online and mailed surveys administered to a random sample of households within

each of 60 census block groups throughout the DMA. To accurately represent residents who were experiencing varying degrees of conflict with coyotes, the sample was evenly stratified (15 census block groups per stratum) to correspond to the four human-coyote conflict density types in the DMA determined by Poessel et al. (2013): no conflict (less than 0.3 reported conflicts per km²), low conflict (0.3-1.4 reported conflicts per km²), medium conflict (1.4-3.6 reported conflicts per km²), and high conflict (3.6-8.6 reported conflicts per km²). The sampling frame was identified using GIS-based county tax parcel data that allowed for mailing addresses to be linked to spatial information, and the targeted number of completed surveys was 68 per census block group to allow for population estimates within +/- 10% at the 90% confidence level for each block group (Scheaffer, Mendenhall, & Ott, 1996). A modified Dillman (2007) approach to survey administration was used, consisting of: an initial cover letter containing a link to the online version of the survey; a mailed copy of the survey to those who had not completed the online version after three weeks; and a reminder postcard mailed three weeks after the mailed questionnaire.

Measurement of Key Concepts

Motivations. To assess volunteer motivations, the on-site survey contained the following open-ended question: “What made you want to join Coyote Watch?”. Motivations were measured on the online volunteer survey by asking, “Why did you join Coyote Watch?”. For the latter, participants were given a set of fixed response options (including an “other, please specify” category) and instructed to select one or more as reasons for joining the program (Table 2.1). Development of these response choices was informed by the on-site survey responses and by an informal elicitation to identify motivations that was conducted by the Coyote Watch program director with a small sample of new program volunteers ($n = 26$) in January 2012.

Demographic characteristics. We used fixed response options to measure gender and education, and volunteers were asked in an open-ended format to record their age, as well as the number of children under 18 living at home. Volunteers were also asked to indicate if they had any of the following domestic animals at their residence: dogs, cats, chickens or “other animals, please describe”.

Attitudes. Attitudes are evaluations of specific issues or objects that form the basis for human behavior (Ajzen & Fishbein, 1980; Manfredo, Teel, & Bright, 2004). General attitudes toward coyotes were measured by asking, “Overall, do you think having coyotes in the area near your home is good, bad, or neither?” Responses were recorded on a scale from 1 “extremely bad” to 7 “extremely good”. Attitudes toward management strategies for dealing with negative human-coyote interactions were measured on a 7-point scale from “highly unacceptable” to “highly acceptable”. Management actions included “leave the coyote alone/monitor the situation”, “frighten or haze the coyote away”, “capture and relocate the coyote to another area”, “lethally remove the coyote” “lethally remove all coyotes found in the area”, and “provide education for local residents about how to deal with coyotes near their homes”.

Beliefs. According to attitude theory, beliefs are the mental cognitions which form the foundation for attitudes and represent perceptions about outcomes of a given issue or behavior (Ajzen & Fishbein, 1980; Manfredo, Teel, & Bright, 2004). Beliefs were measured using a set of 12 statements intended to represent advantages and disadvantages of having coyotes present in the area near one’s residence (Table 2.2). Development of these statements was informed by a phone elicitation to identify salient beliefs about coyotes that was conducted with a small random sample ($n = 25$) of DMA residents for the broader DMA survey project in October 2012 (see

Don Carlos et al., unpublished data). Respondents indicated their level of agreement with each statement on a scale from 1 “strongly disagree” to 7 “strongly agree”.

Behavioral intentions. Behavioral intentions are a measure of a person’s willingness to perform a particular behavior and are considered to be the immediate antecedent to behavior (Ajzen, 1991). Behavioral intentions were measured by asking respondents to indicate how likely they were to participate in certain activities that minimize the risk of negative interactions with coyotes. Activities included supervising pets when outdoors, storing garbage or pet food indoors or in a garage/shed, hazing coyotes seen near their homes, and alerting local authorities about coyotes seen near their homes. Responses were recorded on a scale from 1 “very unlikely” to 5 “very likely”.

Data Analysis

Survey data were entered and analyzed in SPSS v. 21 (SPSS Inc., 2012). Responses to the fixed-choice motivation item from the online survey were coded as 1 “yes, this was a motivation” or 0 “no, this was not a motivation”. Responses to the open-ended motivation question from the on-site survey were coded using open, axial, and selective coding techniques to determine major thematic categories (Neuman, 2006). First, responses were examined for broad patterns and condensed into coded categories. Next, the resulting codes were applied to combine similar concepts and identify subcategories within the themes. For example, the theme “previous experience with coyotes” was separated into two subcategories: “had a previous positive interaction with coyotes” and “had a previous negative interaction with coyotes” to understand more specifically what experiences may have driven some individuals to join Coyote Watch. As another illustration, the same process was applied to the theme “a concern for the safety of pets and children” to differentiate, using separate subcategories, between those

individuals who may have expressed concern for one group, but not the other. Triangulation of the data was achieved by using multiple data sources (i.e., multiple surveys and the previous elicitation; Olsen, 2004).

Independent samples *t*-tests were conducted to compare Coyote Watch volunteers and respondents from the larger DMA coyote study on attitude, belief, and behavioral intention measures. An alpha level of $p < .05$ was used to designate statistical significance, and effect size measures (Cohen's *d*) were computed to determine practical significance of findings. We used accepted criteria (Cohen, 1988; Vaske 2008) to determine small, medium, and large effects ($d > .20, .50, .80$). Exploratory Factor Analysis (EFA) of belief statements was conducted initially in an attempt to reduce the number of variables into logical groups; however, because none of the item groupings met the criteria of having Eigenvalues of at least one and factor loading greater than .40 for the volunteer survey, we chose to use each belief statement individually in subsequent analyses. We recognize this as one of the possible limitations of the small sample size of the volunteer study.

Comparisons of attitudes toward coyote management actions between volunteers and respondents from the larger DMA coyote study were also facilitated by using a graphic display procedure known as the Potential for Conflict Index (PCI₂) (Manfredo, Vaske, & Teel, 2003; Vaske, 2008; Vaske, Beaman, Barreto, & Shelby, 2010). The PCI₂ statistic, with values ranging from “0” to “1”, provides an indication of the amount of dispersion around the mean; a larger value signifies a greater amount of within-group variability or “potential for conflict”.

Results

Seventy-one of the 81 new volunteers to Coyote Watch completed the on-site survey, resulting in an 88% response rate. Additionally, 67 of the 128 previously trained volunteers

completed the online survey (52% response rate). Two surveys in this group were eliminated due to missing data. The response rate for the larger DMA coyote study was 20% ($n = 4,129$) after surveys that were unable to be delivered were eliminated from the analysis. Of these respondents, 66% chose to complete the survey online.

Motivations to Join Coyote Watch

The coding of the responses to the open-ended motivation question appearing on the on-site survey resulted in nine main (“major”) motivations for joining Coyote Watch: to learn about coyotes, enjoy watching wildlife, to donate time, to learn to live with coyotes, to inform others about coyotes, a concern for the safety of pets, a concern for the safety of children, had a previous negative interaction with coyotes, and had a previous positive interaction with coyotes.

Four additional, less commonly reported motivations that were identified included:

curious/interested in coyotes and coyote-related issues, like coyotes, to protect coyotes, and to participate in research.

In addition to these 13 motivations, previously trained volunteers also identified five new reasons for participating on the online survey: an activity to do with the family, previous experience with coyotes (without positive or negative connotation), related to their career, already volunteer with another program in a related field, and enjoy the outdoors. This resulted in a combined total of 18 reported motivations for joining the Coyote Watch program (Table 2.1).

Comparisons of Coyote Watch Volunteers to DMA Residents

Demographic characteristics. Descriptive analysis revealed that the majority of Coyote Watch participants were female (56%), with a median age of 50, did not have children under the age of 18 living at home (80%), and owned pets (56%; Table 1.3). In comparison, the larger

DMA coyote study sample had nearly equal numbers of male and female respondents (49% female), a median age of 50, and a majority who owned pets (55%) and did not have children at home (67%). Both survey groups were highly educated, with 100% of Coyote Watch volunteers and the larger DMA study respondents reporting they had a high school diploma or equivalent. Additionally, 76% of Coyote Watch volunteers and 79% of DMA study participants had a bachelor's degree or higher. These results revealed that Coyote Watch volunteers had characteristics similar to those of respondents from the larger DMA coyote study, such as their age, pet ownership, and number of children living at home, but the volunteers were more likely to be female.

Attitudes. The independent samples *t*-test analysis indicated that Coyote Watch volunteers' general attitudes toward coyotes before participating in the program ($M = 5.02$) were significantly different from those of respondents to the larger DMA survey ($M = 4.00$) ($t(144) = 7.73, p < .001, d = .62$). Sixty-five percent of volunteers felt that having coyotes in the area near their residence was positive, compared to 41% of the DMA respondents. The attitudes of the two groups toward certain management strategies for dealing with negative human-coyote interactions were also significantly different (Table 2.4). Actions that volunteers deemed more acceptable than DMA survey respondents included: "frighten or haze the coyote away", "leave the coyote alone/monitor the situation", and "provide education for local residents about how to deal with coyotes near their homes". Results indicated that volunteers of Coyote Watch were also less accepting of the actions: "capture and relocate the coyote to another area", "lethally remove the coyote", and "lethally remove all coyotes found in the area" compared to the larger DMA resident sample. Graphic illustrations using the PCI_2 statistic also showed statistically significant variability between groups on these attitudinal measures (Figures 2.1-2). For example,

volunteers were more homogeneous as group and more likely to be in consensus with respect to their attitudes regarding the acceptability of management actions than DMA respondents, who were more variable in their responses. This was especially true for lethal control measures and hazing. Nevertheless, while attitudes were statistically different across groups, a majority of both the volunteers (80%) and DMA coyote study respondents (67%) generally did not support lethal control of individual coyotes; or lethal removal of all coyotes in the area (93% of volunteers and 80% of DMA survey respondent were against this measure). Additionally, both the volunteers (99%) and participants in the larger DMA coyote study (94%) tended to approve of providing education to local residents about coyotes. The effect sizes for these attitudinal comparisons were medium to large, with a stronger association noted for capture/relocation and lethal control strategies.

Beliefs. Prior to participation in the program, volunteers were significantly more likely than DMA survey respondents to agree with statements representing the advantages of having coyotes present in their communities (73%-92%) (Table 2.1). In addition, volunteers were less likely than DMA study participants to agree with statements representing the disadvantages of having coyotes around (8%-16%) and the potential risks posed by the species (21%-78%). Only eight percent of volunteers indicated that coyotes do not belong in areas near their homes, compared to 22% of DMA survey respondents. However, it is worth noting that effect sizes for beliefs regarding the general risks that coyotes may pose ($d = .26$) and the potential threat to pets ($d = .16$) were much smaller than those of other belief measures, suggesting a weaker association between variables.

Behavioral intentions. Analysis revealed that, before participating in Coyote Watch, volunteers did not differ significantly from DMA study participants in terms of their likelihood

to store garbage indoors, store pet food indoors, or alert local authorities about the presence of coyotes seen near their homes to minimize risk of negative human-coyote interactions (Table 2.5). Volunteers were more likely, however, to supervise their pets when outdoors (88%) and haze coyotes seen near their homes (82%) than DMA survey respondents (75% and 60%, respectively). The effect size for the supervising pets and hazing variable were .34 and .54, suggesting a small to medium level of association between study sample and likelihood of performing these actions.

Discussion

The primary purpose of this study was to explore the motivations and characteristics of HWC citizen science program participants, and the extent to which these individuals represent the broader public in their area. Using a program known as Coyote Watch in the DMA as a case for this investigation, we found that volunteers often had more than one motivation for joining the program and that they did in fact share many of the demographic characteristics of larger DMA-wide residents. However, results determined that Coyote Watch volunteers differed from these respondents in their attitudes, beliefs and behavioral intentions regarding coyotes.

Past studies on motivations for becoming involved in environmental projects, including citizen science initiatives, have found that volunteers want to increase their knowledge, contribute to community, form new social contacts, and develop career-related skills (Asah & Blahna, 2012; Measham & Barnett, 2008). Similarly, Coyote Watch volunteers expressed a desire to increase their knowledge and contribute to their communities by donating their time. However, perhaps due to the more solitary nature of program activities, developing new social networks was not found to be an important motivation in our study. Additionally, there were very few volunteers who stated that they were participating in the program to develop

professional skills to improve their careers. A majority of volunteers were more driven to participate because they enjoyed wildlife, and in particular, they were interested in coyotes and coyote-related issues. This motivational specificity may be due to the fact that the DMA is currently experiencing an elevated rate of conflict with coyotes, resulting in more media attention and greater salience of coyote-related issues for local residents. Consistent with previous research (e.g., Raddick et al., 2010), our findings suggest that volunteer motivations may be highly contextual and therefore not readily extrapolated to other citizen science initiatives. On the other hand, this information could prove useful to wildlife managers in other areas who are dealing with heightened conflict with wildlife, especially coyotes. If a citizen science program is designed to address and fulfill the needs of a target audience, volunteers will find the experience rewarding and will be more likely to participate in the long-term (Dickinson et al., 2012). Additionally, a study by Jordan and colleagues (2011) found that individuals are more likely to take action if they are properly motivated and believe that their actions have an impact. This can be accomplished in part by providing participants with regular feedback through newsletters and other published materials stemming from the research study to highlight the contribution they are making in their communities (Dickinson et al., 2012). Another important consideration for recruiting citizen science volunteers and keeping them engaged in the program long-term is having an effective, committed program coordinator and educator. Designing programs using information about volunteer motivations and utilizing dedicated administrators to manage them may be more likely to succeed in making a difference in situations that depend on the public taking a strong role in HWC prevention and management.

In addition to identifying participant motivations, analyzing the broader characteristics of volunteers is an important step in understanding the potential target audience for citizen science

programs like Coyote Watch. In this case, we found that the characteristics of program participants were similar to those identified by previous research regarding the demographic prototype of citizen science volunteers; participants were more likely to be female, middle aged to retirement age, and to have higher levels of education in comparison to the general DMA population (U.S. Census, 2012). It is useful to know which segments of the public are currently represented in these types of initiatives, as well as which groups may be less likely to participate and why, so that managers can make informed decisions about the potential reach and effectiveness of citizen science as a tool for addressing HWC. Indeed, one common barrier for participation in environmental research identified by previous studies is a lack of awareness of the opportunity to participate (Hobbs & White, 2012; Martinez & McMullin, 2004; O'Brien, Townsend, & Ebden, 2008). Coyote Watch training sessions are often advertised in small local newspapers, so there could be fewer participants in younger demographic categories due to the way it is advertised. Promoting the program using a broader array of media sources, such as television, social networking sites, and government webpages could play a role in attracting the younger volunteer base that the program currently lacks. Furthermore, understanding volunteer characteristics such as pet ownership could offer additional insight into ways to promote the program to certain audiences. As a majority of Coyote Watch volunteers reported owning pets, the program could be marketed in pet stores, veterinary clinics, and other related outlets to increase program visibility. Coyote Watch staff could even consider partnering with local animal organizations to recruit volunteers who may be concerned about the risks that coyotes pose to pets. As a whole, additional research defining ideal marketing strategies for recruiting citizen scientists could help in considering ways to reach missing segments of the public in future programs.

The results of this study also suggest that individuals who participate in citizen science may differ in their attitudes, beliefs, and behavioral intentions from broader audiences. Compared to respondents from the larger DMA resident study, Coyote Watch volunteers had a more positive general attitude toward coyotes; were more likely to believe that there were various advantages to having them present in the area where they live; were less concerned about the potential risks coyotes may pose to children and pets; and were more likely to take certain actions around their homes to prevent conflicts with coyotes from occurring. However, we also detected some similarities between volunteers and DMA study respondents. For example, both groups were generally opposed to lethal control of coyotes and accepting of educational provision for dealing with negative human-coyote interactions. Overall lessons learned are that while volunteers may be similar to their DMA neighbors in certain regards, they tend to feel more positively about coyotes and to take more steps to mitigate negative interactions. Future research is needed to examine if these differences are a result of participation in Coyote Watch or if these volunteers truly represent a unique segment of the DMA population. Citizen science programs aimed at addressing HWC should be evaluated to determine if they have the capacity to change the attitudes, beliefs, and behavioral intentions of their volunteers and assess the effectiveness of this method as a tool to reduce and manage human-coyote conflict.

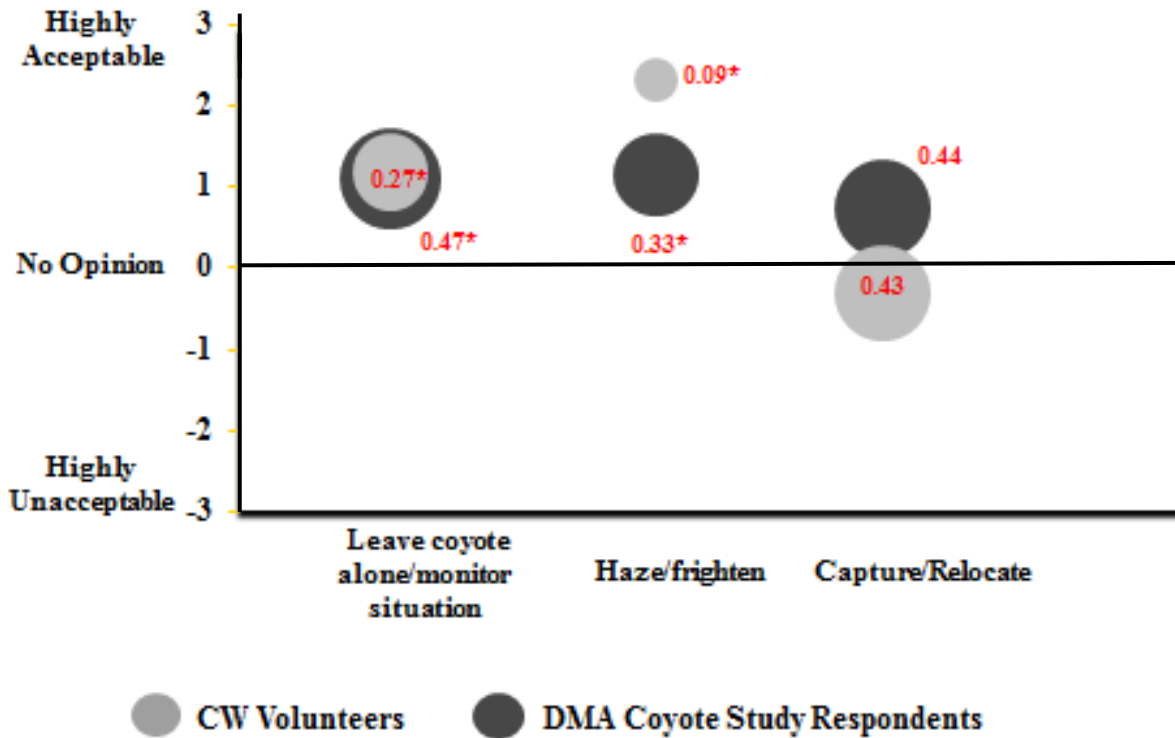


Figure 2.1 Comparison of study participants’ acceptability of management strategies “leave the coyote alone/monitor the situation”, “frighten/haze the coyote”, and “capture and relocate the coyote to another area”.

1. Graphs report mean levels of group acceptability for each action by Coyote Watch volunteers and larger DMA survey respondents.
 2. Values range from “0” to “1”, to provide an indication of the amount of dispersion around the mean. A larger value signifies a greater amount of within-group variability or “potential for conflict”.
- * Differences in PCI values between the groups are significant at $d > 1.96$.

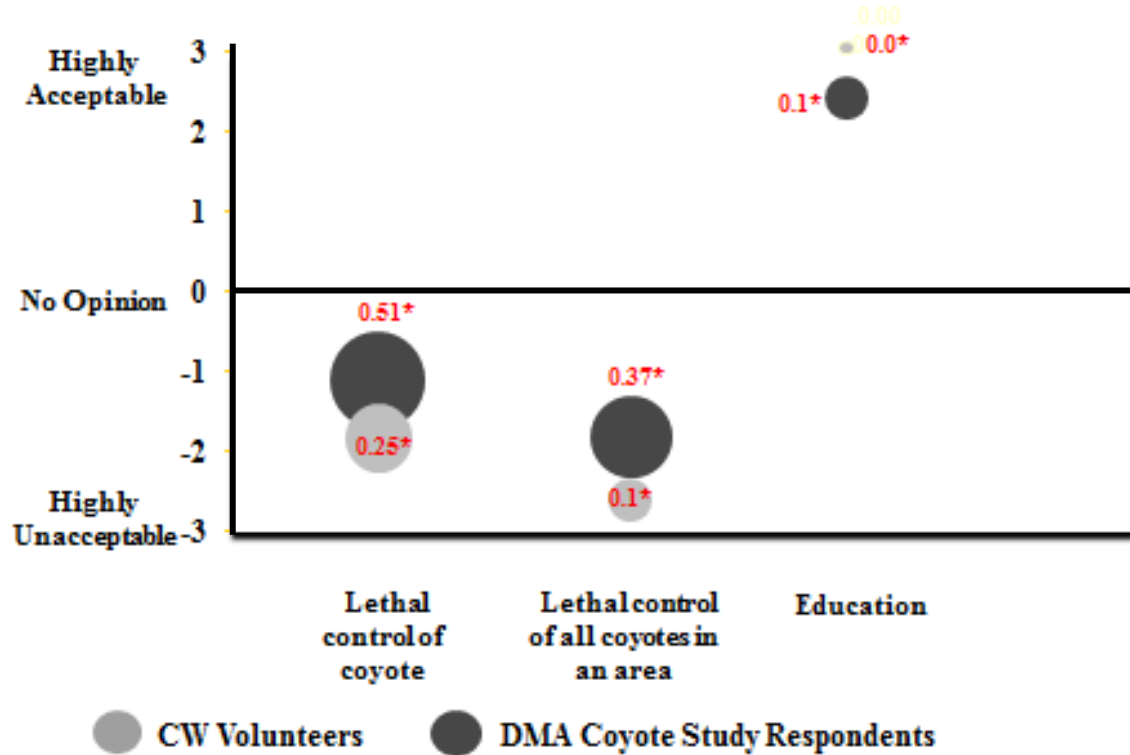


Figure 2.2 Comparison of study participants’ acceptability of management strategies “lethally remove the coyote”, “lethally remove all coyotes found in an area”, and “provide education for local residents about how to deal with coyotes near their homes”.

1. Graphs report mean levels of group acceptability for each action by Coyote Watch volunteers and larger DMA survey respondents.
2. Values range from “0” to “1”, to provide an indication of the amount of dispersion around the mean. A larger value signifies a greater amount of within-group variability or “potential for conflict”.
3. Differences in PCI values between the groups are significant at $d > 1.96$.

Table 2.1 Motivations for volunteers to participate in Coyote Watch.

Motivations ¹	% Agreed
Major²	
Want to learn about coyotes	52.2
Enjoy wildlife	45.5
Wanted to donate time	30.6
Wanted to participate in research	35.8
Previous positive experience with coyotes	7.5
Previous negative experience with coyotes	6.7
Wanted to learn to live with coyotes	30.6
To inform others about coyotes	29.9
Concern for safety of pets	18.7
Concern for safety of children	11.2
Minor³	
Curious or interested in coyotes	41.0
Like coyotes	30.6
Wanted to participate in research	35.8
Wanted to protect coyotes	2.9
Other⁴	
Previous experience with coyotes (no connotation)	14.6
Related to career	8.0
Volunteer in a related field	3.6
Wanted an activity to do with family	3.7
Enjoy outdoors	6.8

1. Items were identified by coding open-ended responses from the on-site survey given to new volunteers. These responses were used to create the choices given to previously trained volunteers on the online survey. Previously trained volunteers also had the option to specify their own motivation if there was no choice that fit. This combination of qualitative and quantitative measurement resulted in 18 total motivational categories.
2. Items that were identified using qualitative coding process as the most frequent motivations reported by new volunteers on the on-site survey.
3. Items that were identified using qualitative coding process as the less common motivations reported by new volunteers on the on-site survey.
4. Items that were identified by previously trained volunteers on the online survey.

Table 2.2 Comparison of study participants' responses to belief statements.

Beliefs ¹	Coyote Watch Volunteers	Larger DMA Study Respondents	<i>t</i> -value	<i>p</i> -value	<i>d</i>
I enjoy seeing coyotes in the area near my home	5.56	4.30	9.22	<.001*	.70
I enjoy knowing coyotes are in the area near my home even if I never see one.	5.35	4.15	8.33	<.001*	.65
Coyotes pose a threat to the safety of children in the area near my home.	2.93	3.97	7.20	<.001*	.58
Coyotes pose a threat to the safety of pets in the area near my home.	4.96	5.50	3.71	<.001*	.16
Coyotes help control populations of rabbits and other small animals in the area near my home	6.29	5.73	5.87	<.001*	.42
There are no benefits to having coyotes in the area near my home.	1.93	2.87	6.74	<.001*	.54
Coyotes are important to the natural ecosystem in the area near my home.	6.23	5.24	8.93	<.001*	.65
Having coyotes in the area near my home is an inconvenience	2.39	3.47	7.21	<.001*	.59
I'm concerned about risks posed by having coyotes in the area near my home.	2.96	4.04	5.88	<.001*	.26
Learning how to co-exist with coyotes is a normal part of living here.	6.55	5.52	14.39	<.001*	.77
Coyotes do not belong in the area near my home.	1.75	2.85	8.87	<.001*	.64
I shouldn't have to change what I do in the area near my home because coyotes are present	2.45	3.49	6.47	<.001*	.54

1. Items measured on a scale from 1="strongly disagree" to 7="strongly agree".

2. Effect sizes were calculated using Cohen's *d*. Indices of .20, .50 and .80 indicate small, medium, and large effects.

* Results are significant at a $p < .05$ level.

Table 2.3 Comparison of study participants' characteristics.

Characteristic Variables	Coyote Watch Volunteers	Larger DMA Study Respondents
Gender (% Female)	55.6	48.8
Median Age	50.0	50.2
Education Level ¹ (%)		
High School Diploma	100	99.6
Four year degree or higher	76.0	79.2
Respondents that do not have any children under age of 18 living in home	80.2	66.8
Pet ownership (%)		
Dogs	55.5	55.2
Cats	33.6	23.1
Other	10.9	5.7

1. Item measured by selection of fixed responses: less than high school diploma, high school diploma or equivalent, 2 year associates degree or trade school, 4 year college degree or advanced degree beyond 4 year college degree.

Table 2.4 Comparison of study participants' attitudes toward management actions.

Attitudes ¹	Coyote Watch Volunteers	Larger DMA Study Respondents	<i>t</i> -value	<i>p</i> -value	<i>d</i>
Leave the coyote alone/monitor the situation	5.71	5.10	4.25	<.001*	.33
Frighten or “haze” the coyote away	6.32	5.15	11.04	<.001*	.78
Capture and relocate the coyote to another area	3.70	4.73	5.81	<.001*	.25
Lethally remove the coyote	2.16	2.88	4.88	<.001*	.38
Lethally remove all coyotes found in the area	1.38	2.17	7.67	<.001*	.49
Provide education for local residents about how to deal with coyotes near their homes	6.86	6.42	10.46	<.001*	.50

1. Items measured on a scale from 1= “highly unacceptable” to 7= “highly acceptable”.
 2. Effect sizes were calculated using Cohen’s *d*. Indices of .20, .50 and .80 indicate small, medium, and large effects.
- Results are significant at a *p* < .05 level.

Table 2.5 Comparison of study participants' behavioral intentions.

Behavioral Intentions ¹	Coyote Watch Volunteers	Larger DMA Study Respondents	<i>t</i> -value	<i>p</i> -value	<i>d</i>
I am likely to store garbage indoors or in a garage/shed	4.22	4.23	0.10	.921	.00
I am likely to store pet foods indoors or in a garage/shed	4.57	4.48	0.91	.365	.04
I am likely to supervise pets when they are outdoors	4.48	4.12	4.62	<.001*	.34
I am likely to frighten or “haze” way a coyote that is near my home	4.23	3.53	6.98	<.001*	.54
I am likely to alert local authorities if I see a coyote near my home	2.13	2.29	1.30	.192	.07

1. Items measured on a scale from 1= “very unlikely” to 5= “very unlikely”.
 2. Effect sizes were calculated using Cohen’s *d*. Indices of .20, .50 and .80 indicate small, medium, and large effects.
- Results are significant at a $p < .05$ level.

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APPENDIX I: INTERVIEW PROTOCOL

Greetings,

My name is Morgan Adams and I am a graduate student at Colorado State University (CSU). In partnership with the City of Aurora, CSU is conducting a study entitled “Evaluating the Role of a Citizen Science Program in Mitigating Urban Coyote Conflict in the Denver Metro Area.” The purpose of our research is to evaluate the outcomes of Coyote Watch and to demonstrate the utility of the program as a tool for community outreach, as well as offer insight for informing other similar programs aimed at addressing human-wildlife conflict situations in urban areas. We would appreciate the opportunity to interview you about your experiences participating in this program. The purpose of these interviews is to learn more about your perceptions of the Coyote Watch curriculum, and coyote issues more generally, as well as to hear about what impacts you think the program has had on you.

Depending on the breadth of your experiences, the interview is estimated to take approximately 30-45 minutes. In accordance with federal regulations, the CSU Institutional Review Board (IRB) has reviewed and approved this study. Participation is voluntary and if you decide to participate you have the option of answering or declining to answer any questions, and you may withdraw your consent and stop participating at any time. Any responses you do provide will remain completely confidential. **Your name, contact information, and any other personally identifying information will never in any way be released or associated with your responses in reporting of the data.** In addition, there are no known risks or direct personal benefits associated with your participation in this study. If you have questions about your rights as a participant in this research, you may contact Janell Barker, CSU IRB Administrator at (970) 491-1655.

As a recipient of this letter, you have been previously contacted by Mary Ann Bonnell, director of Coyote Watch and Senior Natural Resource Specialist for the City of Aurora, and you have given your permission to be contacted by us. **If you are still willing to participate in this study, please reply to this email to coordinate a day and time that is convenient for you and provide a telephone number where you can be reached. We would be happy to answer any questions you might have regarding the study.** Feel free to contact myself or my CSU advisor with questions by phone or email (contact information provided below). Thank you very much for your time and assistance.

Sincerely,

Tara Teel

Morgan Adams

Interviews with Coyote Watch Volunteers Protocol

To start, I would like to tell you about the purpose of this interview. Our research team at CSU has teamed up with several Denver metro area government agencies, including Adams County and the City of Aurora, as well as the National Wildlife Research Center at the USDA to understand current issues related to coyotes and coyote management in the Denver area. As part of this overall project members of our team have been mapping reported coyote incidents, monitoring coyote movement and behavior using tracking collars, talking to local wildlife managers, and we will soon be putting out a survey to local residents about their opinions on coyote issues. Mary Ann has been an important partner in all of this, and as part of the broader project, we want to find out more about her Coyote Watch program by conducting interviews with participants. This program has been very innovative in terms of its ability to involve citizens in informing us on the everyday behavior of coyotes and the effectiveness of hazing strategies. The purpose of these interviews is to learn more about your perceptions of the program, and coyote issues more generally, as well as to hear about what impacts you think the program has had on you.

Coyote Watch Program

1. How long have you been involved in the Coyote watch program?
2. How did you hear about the program?
3. What made you want to join the program?
4. Prior to participating in the program, had you ever had any experiences with coyotes? If yes, can you tell me a bit about those experiences and when they occurred? Can you tell me about any experiences you've had since joining the program?
5. Are there things you feel you've learned as a result of participating in the program?
6. Do you feel that the program has had an impact on you, and if so, how?
 - a. Do you feel it's affected any of your habits or behaviors? (explain)
 - b. Do you feel it's affected your opinion about coyotes? (explain)
 - c. Since joining the program, have you discussed coyotes or coyote issues with other individuals (approx. how many)?
7. Do you have any suggestions for possibly improving the program for future participants?

Now I'm going to ask you a few more general questions about coyotes and coyote-related issues.

Attitudes/Beliefs about Coyotes

1. What, if any, do you believe are the advantages to having coyotes in your area?
2. What, if any, do you believe are the disadvantages to having coyotes in your area?
3. Considering the different types of conflict I mentioned, do you think it is ever ok to lethally remove coyotes? (explain)
4. What do you think about other possible techniques for dealing with these situations, including relocation, hazing, and educating people?
5. Have you participated in hazing coyotes? Why, why not? What methods were used?

If you have any questions or comments regarding this interview, or our collaborative research project, please feel free to contact either myself, or my advisor Dr. Teel.

Morgan Adams

Tara Teel, Ph.D.

APPENDIX II.

ON-SITE PRE-PROGRAM SURVEY FOR NEW VOLUNTEERS

The Denver Metro Area Coyote Watch Program

Thank you for your interest in the Denver Metro Area Coyote Watch Program. This program is intended to involve citizens in monitoring everyday coyote behavior and assessing the effectiveness of hazing strategies. The purpose of this survey is to understand your views about coyotes and coyote issues in general, as well as to help determine the outcomes of the Coyote Watch Program. Participating in this survey is completely voluntary and confidential. Your name and contact information will never in any way be released or associated with your responses in reporting the study results.

- 1. How well informed are you on the topic of coyotes in the area near your home? (Please circle your response.)**

Not at all <u>informed</u>					Somewhat <u>Informed</u>			Extremely <u>Informed</u>
1	2	3	4	5	6	7		

- 2. Overall, do you think having coyotes in the area near your home is good, bad, or neither?**

Extremely Bad	Moderately Bad	Slightly Bad	Neither	Slightly Good	Moderately Good	Extremely Good
1	2	3	4	5	6	7

- 3. To what extent do you agree or disagree with the following statements about coyotes in the area near your home (including your place of residence and the area within a few miles of it)? (Please circle one number for each statement.)**

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither	Slightly Agree	Moderately Agree	Strongly Agree
I enjoy seeing coyotes in the area near my home.	1	2	3	4	5	6	7
I enjoy knowing coyotes are in the area near my home even if I never see one.	1	2	3	4	5	6	7
Coyotes pose a threat to the safety of children in the area near my home.	1	2	3	4	5	6	7
Coyotes pose a threat to pets in the area near my home.	1	2	3	4	5	6	7
Coyotes help control populations of rabbits and other small animals in the area near my home.	1	2	3	4	5	6	7
There are no benefits to having coyotes in the area near my home.	1	2	3	4	5	6	7

Coyotes are important to the natural ecosystem in the area near my home.	1	2	3	4	5	6	7
Having coyotes in the area near my home is an inconvenience.	1	2	3	4	5	6	7
I'm concerned about risks posed by having coyotes in the area near my home.	1	2	3	4	5	6	7
Learning how to co-exist with coyotes is a normal part of living here.	1	2	3	4	5	6	7
Coyotes do not belong in the area near my home.	1	2	3	4	5	6	7
I shouldn't have to change what I do in the area near my home because coyotes are present.	1	2	3	4	5	6	7

4. What made you want to join the Coyote Watch Program?

5. Below is a list of things people may or may not do around their homes in relation to the presence of coyotes. (Please indicate how likely or unlikely you are to take each action by circling a number.)

How likely are you to...	Very Unlikely	Somewhat Unlikely	Neither	Somewhat Likely	Very Likely
A. ...store garbage indoors or in a garage/shed?	1	2	3	4	5
B. ...store pet foods indoors or in a garage/shed?	1	2	3	4	5
C. ...supervise pets when they are outdoors?	1	2	3	4	5
D. ...frighten or "haze" away a coyote that is near your home?	1	2	3	4	5
E. ...alert local authorities if you see a coyote near your home?	1	2	3	4	5
F. ...take other actions related to coyotes near your home? (please describe)	1	2	3	4	5

Which of the actions above do you think is the most effective for minimizing the risk of having negative interactions with coyotes in the area near your home? Please write letter (A-F) _____

6. How acceptable or unacceptable is it for local authorities (e.g., wildlife agencies, city or local county governments) to take the following actions to address negative interactions that may occur between people and coyotes in the area near your home? (Please circle one response for each action.)

	Highly Unacceptable	Moderately Unacceptable	Slightly Unacceptable	Neither	Slightly Acceptable	Moderately Acceptable	Highly Acceptable
Leave the coyote alone/monitor the situation	1	2	3	4	5	6	7

Frighten or “haze” the coyote away	1	2	3	4	5	6	7
Capture and relocate the coyote to another area	1	2	3	4	5	6	7
Lethally remove the coyote	1	2	3	4	5	6	7
Lethally remove all coyotes found in the area	1	2	3	4	5	6	7
Provide education for local residents about how to deal with coyotes near their homes	1	2	3	4	5	6	7

7. For each of the following statements, indicate whether you believe it is “True”, “False”, or are “Not Sure”. (Please circle your response for each statement.)

	True	False	Not Sure
In residential neighborhoods, coyotes’ primary food is domestic pets.	T	F	Not Sure
In urbanized environments, coyotes spend the majority of their time in undeveloped areas.	T	F	Not Sure
Coyotes are strict carnivores (only eat meat).	T	F	Not Sure
Relocating coyotes is the most effective and humane way to resolve coyote conflict with people in the Denver Metro area.	T	F	Not Sure
In areas where coyotes live in close proximity to humans, coyote attacks on humans are rare.	T	F	Not Sure
A coyote following a human while walking a dog is considered to be an aggressive act.	T	F	Not Sure
Coyotes are only active at night.	T	F	Not Sure

The following background information will be used to help make general conclusions about the participants of the Coyote Watch Program. Your responses will remain completely confidential.

1. In the past 3 years, have you experienced a negative interaction (e.g. a pet or human attack) involving coyotes? Yes No

2. In the past 3 years, have you seen a coyote near your home? Yes No

3. Are you...? Male Female

4. What is your age? (Write response.) _____ Years

5. How much formal education have you completed? (Check only one)

Less than high school diploma 4-year college degree

High school diploma or equivalent (for example, GED) Advanced degree beyond 4-year college degree

2-year associates degree or trade school

6. How would you describe the community in which you were raised? (Check one) If more than one area, check the place where you lived the longest.

Large city with 250,000 or more people Town with 10,000 to 24,999 people

City with 100,000 to 249,999 people Town with 5,000 to 9,999 people

City with 50,000 to 99,999 people Small town / village with less than 5,000 people

Small city with 25,000 to 49,999 people A farm or rural area

7. About how long have you lived at your current residence? _____ Years, OR Less than one year. (Write response or check box indicating less than one year.)

8. Do you have any of the following animals at your residence? (Check all that apply.) Dog Cat Chickens Other animals (Please describe.) _____

9. How many people under 18 years of age are currently living in your household? _____

Do you have any additional comments about coyotes or coyote issues in the Denver Metro Area?

Thank you for your participation!!

ONLINE POST PROGRAM SURVEY FOR NEW VOLUNTEERS

Survey

This survey is being conducted by Colorado State University in partnership with the City of Aurora. Your help with this survey is greatly appreciated and will allow us to better evaluate the outcomes of the Coyote Watch Program in the Denver Metro Area.



***1. Please enter your personal four digit password provided in the email you received. This will allow you to enter the survey.**

2. In the survey you completed at your training, we asked you why you joined the Coyote Watch Program. Have you achieved your goals for joining the program?

Yes

No

3. If no, why not?

4. To what extent do you feel that you've learned more about coyotes as a result of your participation in Coyote Watch?

I did not learn about coyotes I learned very little about coyotes I learned some about coyotes I learned quite a bit about coyotes I learned a lot about coyotes

5. Since joining the Coyote Watch Program, about how often do you participate (for example, submit observations) in the program?

Never Less than once a month 1-2 times a month 3-4 times a month More than 3-4 times a month

6. If you have been unable to participate in Coyote Watch or participate less than you would like, are there obstacles that have stopped you? (Check all that apply.)

- Time constraints
- Technology (e.g. internet access issues, difficulty with online form)
- Program different than what I expected
- Observations are not making a difference in my community
- I haven't seen a coyote
- I am not getting enough feedback
- I do not feel valued as a volunteer

Other (please specify)

7. Which activities have you participated in as a volunteer of Coyote Watch? (Check all that apply.)

- Observations
- Submitted observations to program
- Taken pictures of coyotes
- Recorded audio/video of coyotes
- Submitted pictures/audio/video of coyotes
- Hazing
- Talked to others (e.g., neighbors, friends, family, significant other, etc.) about coyotes/coyote issues
- Learned more about coyotes

Other (please specify)

8. Overall, how would you rate the Coyote Watch Program?

Poor Fair Neutral Good Excellent

9. Please indicate one thing you feel you've gained or learned as a result of participating in the Coyote Watch Program.

10. Do you have any suggestions for how the Coyote Watch Program could be improved?

11. What has been the most memorable or valuable aspect of your participation in Coyote Watch so far?

12. How well INFORMED are you on the issue of coyotes in the area near your home (including your place of residence and the area within a few miles of it)?

Not at all informed Somewhat informed Extremely informed

13. Overall, do you think having coyotes in the area near your home is good, bad or neither?

Extremely Bad Moderately Bad Slightly Bad Neither Slightly Good Moderately Good Extremely Good

14. To what extent do you agree or disagree with the following statements about coyotes in the area near your home?

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither	Slightly Agree	Moderately Agree	Strongly Agree
I enjoy seeing coyotes in the area near my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I enjoy knowing coyotes are in the area near my home even if I never see one.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes pose a threat to the safety of children in the area near my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes pose a threat to pets in the area near my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes help control populations of rabbits and other small animals in the area near my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There are no benefits to having coyotes in the area near my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

15. To what extent do you agree or disagree with the following statements about coyotes in the area near your home?

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither	Slightly Agree	Moderately Agree	Strongly Agree
Coyotes are important to the natural ecosystem in the area near my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Having coyotes in the area near my home is an inconvenience.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I'm concerned about risks posed by having coyotes in the area near my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Learning how to co-exist with coyotes is a normal part of living here.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes do not belong in the area near my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I shouldn't have to change what I do in the area near my home because coyotes are present.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Below is a list of things people may or may not do around their homes to minimize the risk of having negative interactions with coyotes. Please indicate how likely or unlikely you are to take each action.

16. How likely are you to...

	Very Unlikely	Somewhat Unlikely	Neither	Somewhat Likely	Very Likely
A...store garbage indoors or in a garage/shed?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B...store pet food indoors or in a garage/shed?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C...supervise pets when they are outdoors?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D...frighten or "haze" away a coyote that is near your home?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
E...alert local authorities if you see a coyote near your home?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
F...take other actions related to coyotes near your home?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please describe other actions.

17. Which of the actions from the list above do you think is the most effective for minimizing the risk of having negative interactions with coyotes in the area near your home? (Please select letter A-F for the ONE action that you think is the most effective.)

18. How acceptable or unacceptable is it for local authorities (e.g., wildlife agencies, city or local county governments) to take the following actions to address negative interactions that may occur between people and coyotes in the area near your home?

	Highly Unacceptable	Moderately Unacceptable	Slightly Unacceptable	Neither	Slightly Acceptable	Moderately Acceptable	Highly Acceptable
Leave the coyote alone/monitor the situation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frighten or "haze" the coyote away	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Capture and relocate the coyote to another area	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lethally remove the coyote	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lethally remove all coyotes found in the area	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provide education for local residents about how to deal with coyotes near their homes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

19. Have you ever hazed a coyote that was acting unafraid or aggressively?

- Yes
- No
- I have never had an interaction with a coyote that was acting unafraid or aggressively

20. If yes, why did you haze the coyote?

21. Which of the following hazing techniques have you used? (Check all that apply.)

- Yelling/Shouting
- Making loud noises with objects
- Throwing small objects like rocks or sticks
- Spraying the animal(s) with water

Other (please specify)

22. If no, why did you choose not to haze?

23. Do you believe hazing coyotes effectively reduces the risk of having negative interactions with these coyotes?

- Yes
- No

If not, please explain why.

24. For each of the following statements, indicate whether you believe it is "True", "False", or are "Not Sure".

	True	False	Not Sure
In residential neighborhoods, coyotes' primary food is domestic pets.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In urbanized environments, coyotes spend the majority of their time in undeveloped areas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes are strict carnivores (only eat meat).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Relocating coyotes is the most effective and humane way to resolve coyote conflict with people in the Denver Metro area.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In areas where coyotes live in close proximity to humans, coyote attacks on humans are rare.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A coyote following a human while walking a dog is considered to be an aggressive act.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes are only active at night.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

People feel a variety of emotions when encountering wild animals or hearing about conflicts between people and wild animals.

25. Please indicate how strongly you agree or disagree with each of the following statements about different feelings towards coyotes.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I get angry when I learn that a coyote has killed someone's pet.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It does not anger me to know that pet dogs and cats may be attacked and killed by wild animals, such as coyotes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I don't understand why some people become angry when coyotes kill pets.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I don't think anyone should be afraid of coyotes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would never worry about my safety in an area that I knew had coyotes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It angers me to learn that coyotes may be destroyed if they harass pets but don't actually kill them.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It saddens me to know that residents may suffer the loss of their pets due to coyote attacks.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

26. Please indicate how strongly you agree or disagree with each of the following statements about different feelings towards coyotes.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I have no sympathy for coyotes that are destroyed for killing pets.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It upsets me to learn that pets have been killed by coyotes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I get angry with local authorities when I hear that residents in the Denver Metro Area may encounter coyotes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have sympathy for residents who lose pets to coyote attacks.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel sorry for coyotes when they are destroyed when they are in urban areas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would not be afraid if I saw a coyote on my property.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It scares me to know that coyotes are living in the Denver Metro Area.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I understand why some people are fearful of coyotes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Thank you for your participation!!!

27. Do you have any additional comments about Coyote Watch, coyotes, or coyote issues in the Denver Metro Area?

ONLINE SURVEY FOR PREVIOUSLY TRAINED VOLUNTEERS

Survey

This survey is being conducted by Colorado State University in partnership with the City of Aurora. Your help with this survey is greatly appreciated and will allow us to better evaluate the outcomes of the Coyote Watch Program in the Denver Metro Area.



***1. Please enter your personal four digit password provided in the email you received. This will allow you to enter the survey.**

2. When did you join the Coyote Watch Program?

Month Year

3. Why did you join Coyote Watch? (Check all that apply.)

- Enjoy watching wildlife
- Wanted to donate my time
- Wanted to participate in research
- I like coyotes
- Activity to do with family
- To learn more about coyotes
- Had a previous negative interaction with coyotes
- Had a previous positive interaction with coyotes
- Want to learn to live with coyotes
- To inform others (neighbors, family, friends, etc.) about coyotes
- Curious/interested in coyotes/coyote issues
- Concerned for the safety of pets
- Concerned for the safety of children

Other (please specify)

4. Have you achieved your goals for joining the Coyote Watch Program?

- Yes
- No

5. If no, why not?

6. To what extent do you feel that you've learned more about coyotes as a result of your participation in Coyote Watch?

I did not learn about coyotes	I learned very little about coyotes	I learned some about coyotes	I learned quite a bit about coyotes	I learned a lot about coyotes
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. Since joining the Coyote Watch Program, about how often do you participate (for example, submit observations) in the program?

Never	Less than once a month	1-2 times a month	3-4 times a month	More than 3-4 times a month
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8. If you have been unable to participate in Coyote Watch or participate less than you would like, are there obstacles that have stopped you? (Check all that apply.)

- Time constraints
- Technology (e.g. internet access issues, difficulty with online form)
- Program different than what I expected
- Observations are not making a difference in my community
- I haven't seen a coyote
- I am not getting enough feedback
- I do not feel valued as a volunteer

Other (please specify)

9. Which activities have you participated in as a volunteer of Coyote Watch? (Check all that apply.)

- Observations
- Submitted observations to program
- Taken pictures of coyotes
- Recorded audio/video of coyotes
- Submitted pictures/audio/video of coyotes
- Hazing
- Talked to others (e.g., neighbors, friends, family, significant other, etc.) about coyotes/coyote issues
- Learned more about coyotes

Other (please specify)

10. Overall, how would you rate the Coyote Watch Program?

Poor Fair Neutral Good Excellent

11. Please indicate one thing you feel you've gained or learned as a result of participating in the Coyote Watch Program.

12. Do you have any suggestions for how the Coyote Watch Program could be improved?

13. How well INFORMED are you on the issue of coyotes in the AREA NEAR YOUR HOME (including your place of residence and the area within a few miles of it) ?

Not at all informed Somewhat informed Extremely informed

14. Overall, do you think having coyotes in the area near your home is good, bad or neither?

Extremely Bad Moderately Bad Slightly Bad Neither Slightly Good Moderately Good Extremely Good

14. To what extent do you agree or disagree with the following statements about coyotes in the area near your home?

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither	Slightly Agree	Moderately Agree	Strongly Agree
I enjoy seeing coyotes in the area near my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I enjoy knowing coyotes are in the area near my home even if I never see one.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes pose a threat to the safety of children in the area near my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes pose a threat to pets in the area near my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes help control populations of rabbits and other small animals in the area near my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There are no benefits to having coyotes in the area near my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

16. To what extent do you agree or disagree with the following statements about coyotes in the area near your home?

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither	Slightly Agree	Moderately Agree	Strongly Agree
Coyotes are important to the natural ecosystem in the area near my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Having coyotes in the area near my home is an inconvenience.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I'm concerned about risks posed by having coyote in the area near my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Learning to co-exist with coyotes is a normal part of living here.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes do not belong in the area near my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I shouldn't have to change what I do in the area near my home because coyotes are present.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Below is a list of things people may or may not do around their homes to minimize the risk of having negative interactions with coyotes. Please indicate how likely or unlikely you are to take each action.

17. How likely are you to...

	Very Unlikely	Somewhat Unlikely	Neither	Somewhat Likely	Very Likely
A...store garbage indoors or in a garage/shed?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B...store pet foods indoors or in a garage/shed?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C...supervise pets when they are outdoors?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D...frighten or "haze" away a coyote that is near your home?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
E...alert local authorities if you see a coyote near your home?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
F...take other actions related to coyotes near your home?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please describe other actions.

18. Which of the actions from the list above do you think is the most effective for minimizing the risk of having negative interactions with coyotes in the area near your home? (Please select letter A-F for the ONE action that you think is the most effective.)

19. How acceptable or unacceptable is it for local authorities (e.g., wildlife agencies, city or local county governments) to take the following actions to address negative interactions that may occur between people and coyotes in the area near your home?

	Highly Unacceptable	Moderately Unacceptable	Slightly Unacceptable	Neither	Slightly Acceptable	Moderately Acceptable	Highly Acceptable
Leave the coyote alone/monitor the situation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frighten or "haze" the coyote away	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Capture and relocate the coyote to another area	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lethally remove the coyote	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lethally remove all coyotes found in the area	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provide education for local residents about how to deal with coyotes near their homes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

20. Have you ever hazed a coyote that was acting unafraid or aggressively?

- Yes
- No
- I have never had an interaction with a coyote that was acting unafraid or aggressively

21. If yes, why did you haze the coyote?

22. Which of the following hazing techniques have you used? (Check all that apply.)

- Yelling/Shouting
- Making loud noises with objects
- Throwing small objects like rocks or sticks
- Spraying the animal(s) with water

Other (please specify)

23. If no, why did you choose not to haze?

24. Do you believe hazing coyotes effectively reduces the risk of having negative interactions with those coyotes?

- Yes
- No

If not, please explain why.

25. For each of the following statements, indicate whether you believe it is "True", "False", or are "Not Sure".

	True	False	Not Sure
In residential neighborhoods, coyotes' primary food is domestic pets.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In urbanized environments, coyotes spend the majority of their time in undeveloped areas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes are strict carnivores (only eat meat).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Relocating coyotes is the most effective and humane way to resolve coyote conflict with people in the Denver Metro Area.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In areas where coyotes live in close proximity to humans, coyote attacks on humans are rare.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A coyote following a human while walking a dog is considered to be an aggressive act.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coyotes are only active at night.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

People may feel a variety of emotions when encountering wild animals or hearing about conflicts between people and wild animals.

26. Please indicate how strongly you agree or disagree with each of the following statements about different feelings towards coyotes.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I get angry when I learn that a coyote has killed someone's pet.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It does not anger me to know that pet dogs and cats may be attacked and killed by wild animals, such as coyotes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I don't understand why some people become angry when coyotes kill pets.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I don't think anyone should be afraid of coyotes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would never worry about my safety in an area that I knew had coyotes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It angers me to learn that coyotes may be destroyed if they harass pets but don't actually kill them.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It saddens me to know that residents may suffer the loss of their pets due to coyote attacks.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

27. Please indicate below how strongly you agree or disagree with each of the following statements about different feelings toward coyotes.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I have no sympathy for coyotes that are destroyed for killing pets.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It upsets me to learn that pets have been killed by coyotes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I get angry with local authorities when I hear that residents in the Denver Metro Area may encounter coyotes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have sympathy for residents who lose pets to coyote attacks.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel sorry for coyotes when they are destroyed when they are in urban areas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would not be afraid if I saw a coyote on my property.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It scares me to know that coyotes are living in the Denver Metro Area.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I understand why some people are fearful of coyotes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The following background information will be used to help make general conclusions about the participants of the Coyote Watch Program. Your responses will remain completely confidential.

28. In the past 3 years, have you experienced a negative interaction (e.g., a pet or human attack) involving coyotes?

- Yes
 No

29. In the past 3 years, have you seen a coyote near your home?

- Yes
 No

30. Are you...?

- Male
 Female

31. What is your age?

32. How much formal education have you completed?

- Less than high school diploma
- High school diploma or equivalent (for example, GED)
- 2-year associates degree or trade school
- 4-year college degree
- Advanced degree beyond 4-year college degree

33. How would you describe the community in which you were RAISED?

- Large city with 250,000 or more people
- City with 100,000 to 249,999 people
- City with 50,000 to 99,999 people
- Small city with 25,000 to 49,999 people
- Town with 10,000 to 24,999 people
- Town with 5,000 to 9,999 people
- Small town/village with less than 5,000 people
- A farm or rural area

34. About how long have you lived at your current residence?

- Less than one year

Type in number of years.

35. Do you have any of the following animals at your residence?

- Dog
- Cat
- Chickens

Other animals

36. How many people under 18 years of age are currently living in your household?

Thank you for your participation!!

37. Do you have any additional comments about coyotes or coyote issues in the Denver Metro Area?