

Do you hear what I hear? Human perception of coyote group size

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Abstract: Coyotes (*Canis latrans*) are considered a cosmopolitan meso-predator because of their widespread distribution throughout North America. Their ecological niche includes rural landscapes, the urban-rural interface, and metropolitan cities and small towns. Human awareness of their presence and relative abundance comes largely from their vocalizations. In September 2015, we played recordings of 1–4 coyotes that were howling and yip-yapping to 427 participants who lived in southern Texas, USA, and asked them to estimate the number of coyotes they perceived to hear. Participants were separated by gender (male or female), age group (≤ 34 or ≥ 35), resident location (urban, suburban, or rural), and occupation type (rancher/farmer or non-rancher/farmer). We did not find any differences between participant perceptions of coyote abundance based on gender, age group, resident location, and occupation type. Participants were able to discern differences in the number of coyotes howling with the addition of each coyote; however, participants consistently overestimated the number of coyotes they heard by nearly 2-fold. To the extent that our surveyed population represented the general public, it appears that the public could develop the misperception that coyotes are more abundant than they actually are.

Key words: *Canis latrans*, coyote, howl, human perception, occupation, relative abundance estimates, residence, occupation, Texas, vocalizations

COYOTES (*CANIS LATRANS*) ARE ELUSIVE meso-predators (Kleiman and Brady 1978, Bekoff 2001) that now inhabit much of North America. Public attitudes about coyotes and their management are largely influenced by their perceptions of the species to include the relative abundance and threats to humans and other wildlife (Messmer et al. 1999). Much of the public's perception of the presence and relative abundance of coyotes in a landscape comes from their vocalizations. Because of this, researchers have employed coyote vocalization surveys as a non-invasive method to estimate coyote population size (Quinton 1976, Laundre 1981, Okoniewski and Chambers 1984).

The elaborate repertoire of coyote vocalizations (i.e., howls, yips, etc.) serve to announce occupancy of a territory for spacing and for territory maintenance (Gier 1975; Lehner 1978a,b; Lehner 1982; Bekoff and Gese 2003). To achieve

territory maintenance, coyotes howl both in their core territory and along the peripheries of their home ranges (Gese and Ruff 1998), and they can be heard up to 3.2 km away, depending on climate conditions (Knudson 1946, Wolfe 1974). Howling most commonly occurs during breeding season and dispersal, during the middle of the night and just before sunrise, and during periods of moderate temperatures (Gese and Ruff 1998). Contrary to folklore, coyote howling is not linked to the intensity of moonlight (Walsh and Lehman 1989); in fact, group howling may be negatively related to intensity of moonlight (Bender et al. 1996).

Coyote vocalizations are common throughout much of Texas, especially in rural areas where farmers and ranchers live. In conversations with the rural community, estimates of the local coyote population were speculated, and often were exceedingly greater than the

highest recorded coyote population estimates (Knowlton 1972). Such high estimates of coyote numbers may be due, in part, to the public's inability to accurately assess the number of coyotes they hear howling. Having a false belief of coyote abundance within an area could exacerbate other misperceptions by the public about coyotes. For example, ranchers who lose livestock to predators may assume the culprit was the perceived most abundant predator in the area—in our example, coyotes; however, often the offending animals actually are a different species (e.g., feral dogs; S. Henke, unpublished data). An inaccurate public perception of coyote abundance also may lead to an inaccurate perceived need for coyote removal in some situations where coyotes are viewed as nuisance animals. Therefore, to test the first aspect of our concept, we hypothesized that the general public is unable to accurately determine the number of coyotes from howling. The objective of our study was to determine the accuracy of the general public in estimating the number of coyotes they hear during coyote vocalizations.

Methods

To ensure a known number of vocalizing animals, 4 coyotes (2 male and 2 female) were live captured during September 2015 from southern Texas via neck snares equipped with a stop device set within crawl holes under fences. Snares were checked every 4 hours, captured coyotes were sedated with 4 mg/kg ketamine hydrochloride and 2 mg/kg xylazine via jab stick (Kreeger and Arnemo 2012), and transported to the predator facility operated by the Caesar Kleberg Wildlife Research Institute. Coyotes were provided food and water *ad libitum* and daily maintenance conducted according to the TAMUK IACUC (2015-05-17) approval.

A 2-tone, electronic siren (Model eSiren-120-240, UltraStrobe Communications, Crystal Lake, Illinois, USA; 104-115 dBA), located within 10 m of coyotes, was used to illicit coyote howling (Wenger and Cringan 1978). Once howling began, the siren was turned off and 5 min of coyote howling was recorded via a Handy Pro (Model H4NPRO, Best Buy, Corpus Christi, Texas, USA) recording device. Coyotes were captured individually and brought to the holding facility 1 at a time so the recording of

howling could be repeated with 1–4 coyotes, respectively. Researchers were present to observe and verify the number of coyotes howling.

We then obtained permission to erect a booth at local grocery stores in Corpus Christi, Kingsville, and Falfurrias, Texas, and solicited patrons to participate in our survey. These cities were selected because they represented rural ranching and urban/suburban communities. Also, Kingsville and Falfurrias have but a single grocery store in their respective towns; therefore, the majority of residents visit the store each week. We requested participants record their gender (male or female), age group (≤ 34 or ≥ 35), resident location (urban, suburban, or urban), and occupation type (rancher/farmer or non-rancher/farmer).

We assumed that participants in the >35 age group had a greater number of opportunities for life experiences with coyotes than the <34 age group, particularly in the rancher/farmer occupation type. Participants then were given headphones to listen to a single coyote recording of either 1–4 coyotes howling and write their estimate of the number of coyotes they believed they heard. Participants were not told the actual number of coyotes in the recording to avoid influencing future participants. Participants used headphones so future participants would not be biased or gain experience by being provided multiple opportunities to hear our coyote recordings. Use of human subjects was approved by the TAMUK IRB committee (Protocol #2015-016).

Data collected were examined with analysis of variance (SAS Institute 2008) to test for differences between main and interactive effects of treatment (i.e., number of coyotes howling in the recording) on participant gender, age group, resident location, and occupation type. Interactive effects did not occur so main effects are reported herein. Multiple comparisons were made with Tukey's studentized range (HSD) test when significant effects were found (Cochran and Cox 1957). Homogeneity of variances among treatments was evaluated with the Bartlett's test (Steel and Torrie 1980). Distributions of residual errors were tested for normality via the Shapiro-Wilk test. All means are reported as ± 1 SE. Significance is inferred at $P < 0.05$.

Results

Four hundred twenty-seven individuals participated in our survey (Table 1). Gender, age group, resident location, and occupation type did not affect participants' perception as to the number of coyotes they heard ($F_{1, 420} = 0.22$, $P = 0.64$; $F_{1, 420} = 0.12$, $P = 0.73$; $F_{1, 420} = 0.59$, $P = 0.44$; $F_{1, 420} = 0.30$, $P = 0.58$; respectively); however, the actual number of coyotes howling did affect ($F_{3, 420} = 392.4$, $P < 0.0001$) human perception. Participants were able to discern differences in the number of coyotes howling with the addition of each coyote; however, participants consistently overestimated the number of coyotes they heard by nearly 2-fold. When participants listened to 1 or 2 coyotes, they thought they heard 1–5 coyotes (Figure 1). Participants believed they heard 3–8 coyotes and 4–12 coyotes when they actually listened to 3 and 4 coyotes howling, respectively (Figure 1). Only 11% ($N = 47$) of participants estimated the correct number of coyotes howling (26, 16, 2, and 3 participants correctly estimated 1, 2, 3, and 4 coyotes were howling); however, <3% of participants could correctly discern if 3 or more coyotes were howling.

Discussion

Our data supported our hypothesis that the general public was unable to accurately determine the number of coyotes from howling. Nearly 90% of the participants overestimated the actual number of coyotes howling. The vocalizations of coyote individuals have been described as a bark, flat howl, yip, yipe, short-howl, warble, laugh, irregular howl, scream, and gargle (McCarley 1975). Add a group dynamic to those sounds with group howl and group yip-howl (Lehner 1978b), and it is no wonder that people tend to overestimate coyote numbers based on sound by nearly 2-fold.

Complex vocalizations may afford coyotes the ability to seem more numerous than they actually are. In wolves (*Canis* spp.), this Beau Geste effect (Harrington 1989) was believed to be used to exaggerate the apparent pack size, particularly in newly established packs, or those packs reduced in number. The consistent overestimates of coyote numbers seen in our study suggested that the same effect may be present with coyotes as well. Perhaps the Beau Geste effect was a learned behavior by coyotes from wolves, or a trait inherited from

the ancestral stock from which red wolves (*C. rufus*), gray wolves (*C. lupus*), and coyotes evolved (Nowak 1979, Wayne et al. 1998).

Studies have estimated coyote density from 0.1–2.3 individuals/km² (Bekoff and Gese 2003), of which the higher end can be found in southern Texas (Knowlton 1972). However, anecdotal reports of higher densities, similar to those espoused in this study, are common. For example, in a companion study (Brewster, unpublished) that surveyed rancher opinion concerning coyotes, nearly 25% of those surveyed believed that coyote density exceeded 8 animals/km². One possibility for the disparity between published densities and perceived densities could be the inability for people to audibly estimate coyote group size, which results in an exaggerated coyote population.

Coyotes are widely viewed as overabundant nuisance animals by Texas ranching communities. For example, ranchers considered coyotes the culprit in 30% of the calf depredation occurrences ($N = 46$) in southern Texas during 2012–2013, when in actuality domestic dogs (*C. familiaris*) were the offenders (S. Henke, unpublished data). As stated earlier, an inaccurate public perception of coyote abundance may lead to an inaccurate perceived need for coyote removal in some situations where coyotes are viewed as nuisance animals. Providing information to the public about a species can impact attitudes toward that species (Messmer et al. 1999). Messmer et al. (1999), in a comprehensive study of public attitudes in the United States regarding the management of meso-predators, reported that public support for predators and their management was affected by their knowledge of the species and their potential impacts. Draheim et al. (2011) reported that public attitudes toward coyotes can best be influenced by providing the general public with information on coyote behaviors. These authors suggested that comprehensive education programs provide the best opportunity to influence public attitudes toward a predatory species. The findings from our howling survey suggest that the public may gain a better understanding of coyotes if appropriate information concerning vocalization behavior were provided to them.

We recognize the limitation of our study to the extent that we extrapolate about the inability of the general public to accurately

Table 1. Perceived number of coyotes (*Canis latrans*) howling by 427 participants of various backgrounds who listened to a recording of 1–4 coyotes actually howling and estimated the number of coyotes heard, south Texas, USA, 2016.

| | | 1 Coyote | | | | 2 Coyotes | | | | 3 Coyotes | | | | 4 Coyotes | | | | | | | |
|--------|----------|-------------|-------------|--------------------------|-----------------|-----------|-----|-------------|-----------------|-----------|-----|-------------|-----------------|-----------|-------|-------------|-----------------|-----------|-------|----|---|
| Gender | Age | Residence | Occupation | N | (\bar{x} SE) | Min | Max | N | (\bar{x} SE) | Min | Max | N | (\bar{x} SE) | Min | Max | N | (\bar{x} SE) | Min | Max | | |
| Male | ≤34 | Rural | Rancher | 15 | 1.9 (0.2) | 1 | 3 | 14 | 3.1 (0.2) | 1 | 5 | 14 | 5.1 (0.2) | 4 | 7 | 14 | 7.2 (0.5) | 5 | 12 | | |
| | | | Non-rancher | 5 | 1.8 (0.4) | 1 | 3 | 5 | 3.0 (0.3) | 2 | 4 | 5 | 5.0 (0.3) | 4 | 6 | 5 | 7.0 (0.4) | 6 | 8 | | |
| | | Suburban | Rancher | 0 | - (-) | - | - | 0 | - (-) | - | - | 0 | - (-) | 0 | - (-) | - | - | 0 | - (-) | - | - |
| | | | Non-rancher | 12 | 1.9 (0.2) | 1 | 3 | 12 | 3.5 (0.3) | 2 | 5 | 11 | 5.7 (0.3) | 5 | 8 | 12 | 6.8 (0.5) | 4 | 10 | | |
| | | ≥35 | Rural | Rancher | 13 | 1.9 (0.2) | 1 | 3 | 13 | 2.8 (0.2) | 1 | 4 | 12 | 4.8 (0.2) | 4 | 6 | 12 | 6.8 (0.6) | 5 | 12 | |
| | | | | Non-rancher | 4 | 2.5 (0.3) | 2 | 3 | 3 | 3.3 (0.3) | 3 | 4 | 4 | 5.8 (0.8) | 4 | 8 | 3 | 7.3 (0.7) | 6 | 8 | |
| | Female | ≤34 | Suburban | Rancher | 0 | - (-) | - | - | 0 | - (-) | - | - | 0 | - (-) | - | - | 0 | - (-) | - | - | |
| | | | | Non-rancher | 15 | 2.3 (0.2) | 1 | 5 | 14 | 3.0 (0.2) | 2 | 5 | 14 | 5.5 (0.2) | 4 | 7 | 14 | 6.9 (0.5) | 5 | 12 | |
| | | | Rural | 11 | 1.9 (0.2) | 1 | 3 | 11 | 3.1 (0.3) | 2 | 5 | 11 | 5.1 (0.2) | 4 | 7 | 10 | 7.4 (0.7) | 5 | 12 | | |
| | | ≥35 | Suburban | Rancher | 0 | - (-) | - | - | 0 | - (-) | - | - | 0 | - (-) | - | - | 0 | - (-) | - | - | |
| | | | | Non-rancher | 8 | 1.8 (0.2) | 1 | 3 | 8 | 3.5 (0.4) | 2 | 5 | 9 | 5.3 (0.2) | 5 | 6 | 8 | 6.8 (0.8) | 4 | 10 | |
| | | | Rural | 10 | 1.9 (0.2) | 1 | 3 | 8 | 2.8 (0.3) | 1 | 4 | 9 | 5.0 (0.2) | 4 | 6 | 6 | 6.2 (0.4) | 5 | 8 | | |
| Total | Suburban | Rancher | 0 | - (-) | - | - | 0 | - (-) | - | - | 0 | - (-) | - | - | 0 | - (-) | - | - | | | |
| | | Non-rancher | 12 | 2.2 (0.3) | 1 | 5 | 11 | 3.0 (0.3) | 2 | 5 | 13 | 5.6 (0.2) | 5 | 7 | 12 | 7.2 (0.6) | 5 | 12 | | | |
| | | D | 112 | 2.0 (0.1) A ² | 1 | 5 | 105 | 3.1 (0.1) B | 1 | 5 | 107 | 5.3 (0.1) C | 3 | 8 | 103 | 7.0 (0.2) D | 4 | 12 | | | |

¹Participants were categorized by gender (i.e., male or female), age group (i.e., ≤34 years old or ≥35 years old), residence type (i.e., rural or suburban; we did not have urban participants in our survey), and occupation type (i.e., rancher/farmer or non-rancher/farmer).

²Means with the same letter are not significant ($P > 0.05$).

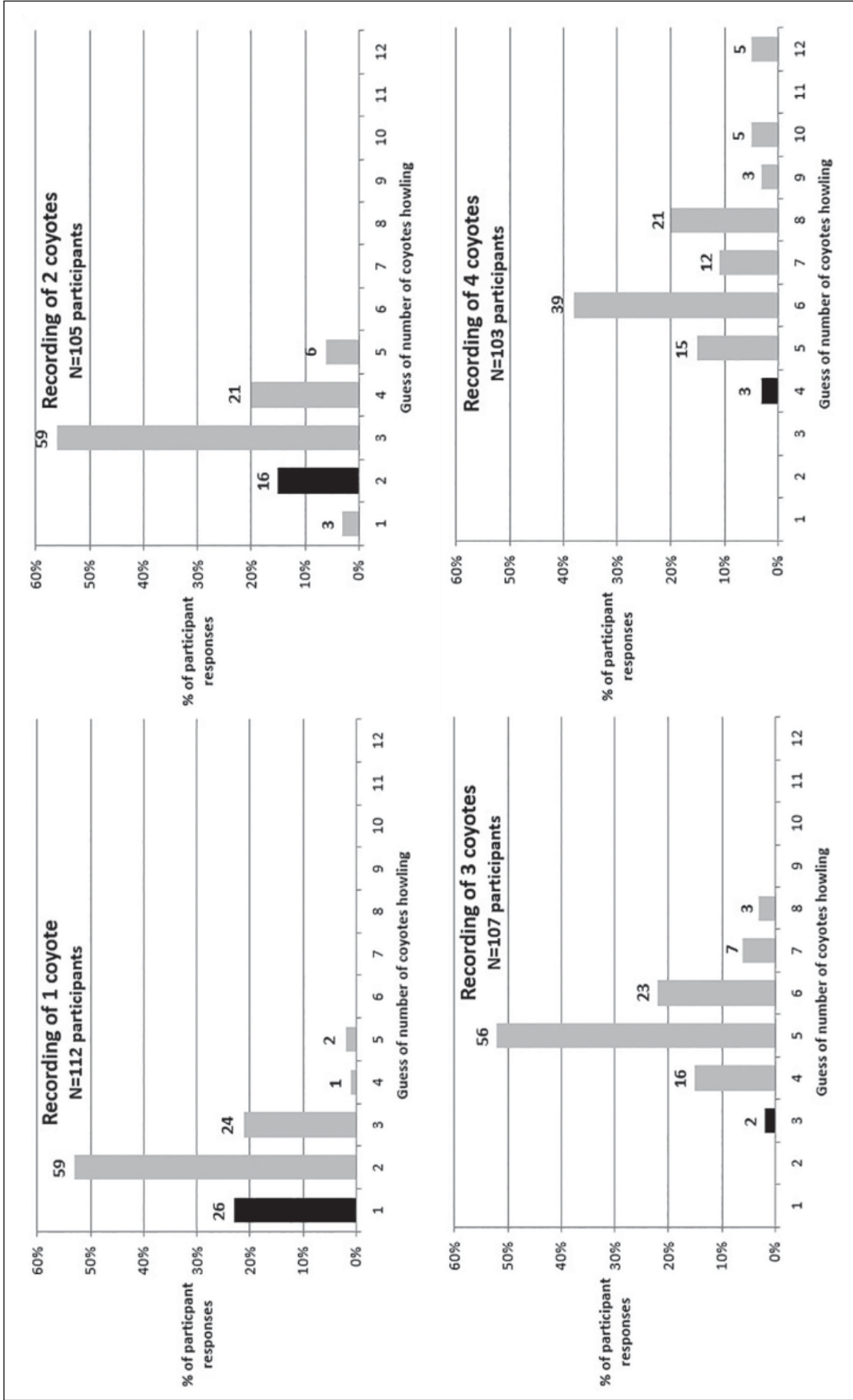


Figure 1. Percentage of participant perception (Y-axis) as to the number of coyotes (*Canis latrans*) they perceived to hear (X-axis) from recordings of 1–4 coyotes, played to 427 patrons of grocery stores in southern Texas, USA in September 2015. The bars represent the percent of responses, and black bars represent the percentage of correct response for each treatment. The numbers above each bar represent the number of participants who guessed that number of coyotes howling.

assess the number of howling coyotes from sampling residents of 3 cities. Every study that uses inferential statistics must make a judgment concerning the relationship between the sampled population and the inferential population (Kendall and Stuart 1983:137). However, we believe that our sample was a fair demographic representation of the general public. Our sample contained people from both sexes and multiple ethnic, economic, educational, and career backgrounds; such a sample could be found in any region of the United States. Also, to our knowledge, no one receives training in assessing the actual number of coyotes heard from their perception, so it is unlikely that our sampled population is biased with more or less ability than the average person. In addition, we recognize that wildlife researchers may be better able to estimate abundance through elicited howling response counts; however, in this case, a bias may exist to underestimate coyote abundance. As non-territorial individuals generally do not respond to other coyote howls, they likely would not respond to sounds used to elicit vocalizations (Henke and Knowlton 1995). Therefore, the true population size of coyotes can prove difficult to ascertain from vocalization responses only.

Management implications

There is an apparent need to educate the public about coyote behaviors and capabilities. Coyote myths (e.g., coyotes are strictly carnivorous, coyotes congregate in unrelated “packs,” and coyotes are highly abundant) are prevalent, and such myths exacerbate the misperceptions that the general public has about coyotes. An education program to improve the knowledge of the public concerning coyotes would help align the public’s beliefs and biological facts about coyotes. One potential inexpensive option for wildlife professionals is to develop a brochure with carefully selected information and graphics about coyotes. Providing such information to groups and individuals who request assistance with coyote nuisance issues could reduce the myths believed about coyotes, which in turn, could begin to change the general public’s perception. We acknowledge that public opinion and beliefs concerning coyotes have developed over several generations, so changing public attitude toward this predator

will take time. However, we advocate that the time to begin educating the public with accurate information about coyotes is now.

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