COYOTE BEHAVIORAL RESPONSE TO SCENT-STATIONS

CHARLES J. RANDEL, III,[1,2] Sapphos Environmental, Inc., 430 N. Halstead St., Pasadena, CA 91107, USA

ANGELA D. PEACE,[3] Sapphos Environmental, Inc., 430 N. Halstead St., Pasadena, CA 91107, USA

ABSTRACT Relative abundance indices, specifically scent-stations, have been used throughout North America to monitor coyote (*Canis latrans*) abundance trends. Previous studies have focused on captive coyote's reaction to the introduction of novel objects to enclosures to predict behavioral responses of wild coyotes. No previous study has evaluated the behavioral response of wild coyotes to the introduction of scent-stations within their range. We conducted quarterly scent-station transects in western Riverside County, California with each station supplemented with continuously active motion sensitive cameras. The most common behavioral responses were no reaction (44.3%, n = 31) and visual/olfactory inspection (42.9%; n = 30), with avoidance (10.0%; n = 7), scent marking 1.4%; n = 1), and rub-rolling (1.4%; n = 1) documented. Our results indicated short duration scent-station indices may underestimate coyote abundance.

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Relative density indices (e.g., scat transects, hair snares, and scent stations) are widely used by wildlife biologists and resource agencies to track population trends in mammalian species including coyotes (*Canis latrans*; Sargeant et al. 1998). The use of relative density indices for coyotes has been the subject of many studies throughout North America, with those studies reporting various degrees of success (Davis 1981, Conner et al. 1983, Sargeant et al. 1998).Discussions within the literature regarding the application of scent-stations as a viable index for monitoring mammalian densities are ongoing and focus primarily on methodology including: non-random species distribution, seasonal and regional movements, behavioral patterns, weather, food supply, habitat (Linhart and Knowlton 1975), and scent lure attraction (Roughton and Sweeny 1982).

Roughton and Sweeny (1982) suggested the efficiency and reliability of the scent-station method are influenced by the quality and quantity of the odor attractant used, presentation method, sampling design, and sensitivity of the data to analysis (Roughton and Sweeny 1982). Evaluations of the efficiency and reliability of the scent-station method to this point have focused solely on the physical aspects of the scent-station and have not reliably accounted for behavioral responses of target species when confronted with the introduction of a novel object in the environment.

Recent research has focused on captive coyotes' responses to the introduction and removal of novel objects (e.g., small and large traffic cones; Haffernan et al. 2007). Haffernan et al. (2007) found captive coyotes spent a greater amount of time investigating introduced small novel objects when compared to larger objects. However, little research has been conducted evaluating coyote response to the introduction of scent-stations (Linhart and Knowlton 1975).

To our knowledge, one previous study has attempted to determine behavioral responses of wild coyotes to novel objects (Harris and Knowlton 2001). We conducted a study to assess behavioral responses of wild coyotes in southern California to scent-stations. The objective of our study was to evaluate wild coyote response behaviors to scent-stations by placing motion sensitive cameras at scent stations.

STUDY AREA

Our study area was approximately 306 ha within the Prado Basin, western Riverside County, California. Climate was considered Mediterranean and characterized by relatively cool dry summers and warm wet winters. The average annual precipitation was 30.9 cm, with an average daily temperature of 19.6º Celsius (Western Regional Climate Center 2007). The dominant plant community present within

[1] Present address: Randel Wildlife Consulting, Inc., South Pasadena, CA 91030
[2] Email: randel.wildlife@gmail.com
[3] Present address: Tetra Tech, Buffalo, NY 14203

the study was Diegan Coastal Sage Scrub (Holland 1986). Diegan Coastal Sage Scrub was dominated by California sage (*Artemisia californica*), red brome (*Bromus rubens*), brittlebush (*Encelia farinosa*), and California buckwheat (*Eriogonum fasciculatum*). Diegan Coastal Sage Scrub was typically located on steep, xeric sites with severely drained soils or clay soils that released stored soil moisture slowly (Holland 1986).

METHODS

Scent-stations consisted of a 1- m diameter circle of sifted gypsum and commercial predator lure (Carmine's Pro Choice) applied to a Q-tip®, centrally placed in the scent station. We established 10 scent-stations adjacent to State Route 71 (SR–71), an elevated north-south oriented 4-lane divided highway, in western Riverside County, California. Scent-stations were alternately placed on the east and west right-of-way and were active 3 days/month. We recorded tracks present each morning and smoothed the gypsum to record tracks for the subsequent day in accordance with the methodology established by Linhart and Knowlton (1975).

We placed motion sensitive cameras, at scent-stations and non scent-stations, against fixed objects to prevent coyote approach from behind the camera thereby reducing detection probability. Digital images were collected from November 2004–October 2005, 24-hours/day (time and date stamped), 7-days/week using motion sensitive cameras (Cuddeback digital scouting camera, Non Typical Inc.) and placed at potential wildlife crossings adjacent to SR-71 and scent station locations. Digital media cards were collected and batteries and media cards were replaced bi-monthly.

RESULTS

We collected 3,445 photographs from November 2004 to October 2005 of which 97 were coyote images, representing 1.1 coyote images/month/camera station. Twenty-seven coyote images were collected at locations with no scent-station present and 70 images were collected at scent-stations.

We classified coyote images into five categories (no reaction, visual/olfactory inspection, avoidance, scent marking, or rub-roll; Figures 1a-1e) based on behavioral reactions to novel stimuli. We observed no interactions with cameras at monitoring locations when no scent-station was present; therefore the 27 images were classified as no reaction. We observed all categories of potential behavioral interactions at camera stations where scent-stations were present: no reaction ($n = 31$), visual/olfactory inspection ($n = 30$), avoidance ($n = 7$), scent marking ($n = 1$), rub-roll ($n = 1$).

DISCUSSION

Our data suggest scent-stations are effective at attracting coyotes based on photographic captures at scent-stations ($n = 70$) when compared to photographic captures where no scent-stations were present ($n = 27$). We observed no behavioral response of coyotes to monitoring stations where cameras, a relatively small object, were present with no scent-station. Our findings were inconsistent with Haffernan et al. (2007) that suggested captive coyotes readily investigated small novel objects during experimental trials. We placed cameras in areas where approach from behind was not likely, but do acknowledge the possibility for camera investigation from angles which resulted in no collected photographs.

Because behavioral responses can vary between individuals based on age, sex, social status, and previous trapping experience (Linhart and Knowlton 1975) coyote response could be variable when confronted with scent-stations. Linhart and Knowlton (1975) reported coyotes "occasionally" ignored scent-stations. While direct comparisons to vague modifiers such as occasionally are not possible, our data indicate coyotes ignored scent-stations 44% of the time during our study, which was the most common response recorded. Because behavioral responses can vary between individuals based on age, sex, social status, and previous trapping experience (Linhart and Knowlton 1975), coyote response is expected to be variable when confronted with scent-stations.We also documented seven instances of avoidance behavior (e.g., running) when scent stations were present. It is possible avoidance behaviors were documented in response to environmental stimuli not associated with scent-stations (e.g., traffic) or delayed camera response time combined with the camera flash startled coyotes and avoidance behavior was a reaction to the camera flash not scent-station avoidance.

Visual/olfactory investigation of unknown scents by coyotes has been well documented in experiments with captive coyotes (Gese and Ruff 1997, Harris and Knowlton 2001, Heffernan et al. 2007). Our results found visual/olfactory inspection of scent-stations to be the second most common response (42.9%; $n = 30$) by coyotes during our study. Harris

and Knowlton (2001) reported that captive coyotes approached objects or scent-stations cautiously, stretching forward for visual/olfactory inspection within 1-2 m of the objects. During our study we recorded only one such approach with 97% of visual/olfactory inspections photographed having coyotes directly on top of the scent-stations.

Two additional coyote responses were recorded in response to scent-stations on single occasions: scent marking and rub-roll (Figure 1d and 1e, respectively). The scent marking was performed on 11 November 2004 and was bent leg urination. Gese and Ruff (1997) reported female coyotes performed squat scent marking 92.1% of the time while males scent marked in a raised leg or standing position 84.4% of the time. The most commonly reported reason for scent marking behavior is territoriality with no overlapping scent marking occurring between packs (Allen et al. 1999). Scent marking has also been suggested as a mechanism for sex recognition (Bekoff 1979) and an indicator of breeding condition (Beckoff and Diamond 1976). Harrington (1982) documented urine marking of food and caches by captive coyotes, but this has not been observed in wild coyotes. Although sign-posting has not been attributed to wild coyotes, it is plausible that scent-stations may elicit a form of sign-posting behavior due to the introduction of unknown scents into a territory. Further investigation would be required to corroborate this assumption.

We documented one instance of a rub-roll behavioral response to a scent-station on 15 November 2004. The rub-roll behavior is most frequently documented during summer and early fall (Bekoff and Diamond 1976, Andelt 1985) and has been attributed to the attractiveness of a lure (Phillips et al. 1990), improved social status and mate attraction (Martin and Fagre 1988), and early courtship and pair bonding (Bekoff and Diamond 1976, Andelt 1985), with both males and females exhibiting the behavior (Heffernan et al. 2007).

Through the use of camera monitoring of scent-stations in western Riverside County, California we documented five possible coyote behavioral responses to scent-stations: no response, visual/olfactory inspection, avoidance, scent marking, and rub-roll. While each of these responses has been documented in captive coyote experiments in response to novel objects no previous research has tested reactions of wild coyotes to scent-stations. Our results suggest scent-station indexes have the potential to under represent wild coyote abundance based on a 44% no response rate to scent-stations. Further research should be conducted to determine if our results are typical and we suggest combining camera monitoring stations in conjunction with scent-stations to assess behavioral reactions of wild coyotes to scent-station indices.

MANAGEMENT IMPLICATIONS

We found that coyotes had five potential reactions to the installation of scent-stations in western Riverside County, California. With the use of motion sensitive cameras we found that approximately 42% of coyotes ignored scent stations which may underestimate abundances at short temporal scales. We suggest the use of motion sensitive cameras, which were not inspected by coyotes, in conjunction with scent-stations provide more reliable estimates of coyote presence.

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