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Coyote visitation to water sources as evidence of a decline in coyote numbers

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Patterns of activity in coyotes have been shown to vary with environment. Coyotes in urban environments show a nocturnal activity pattern (McClennen et al. 2001, Riley et al. 2003, Way et al. 2004). Conversely, in natural undisturbed environments coyote activity is more diurnal (Kitchen et al. 2000). Coyotes in a pine-oak forest in Durango, Mexico showed similar distance traveled diurnally versus nocturnally (Servin et al. 2003). It was postulated that habitat type, rather than latitude, influences the amount of distance traveled daily for coyotes (Servin et al. 2003). Despite many studies on coyote activity using radio telemetry (e.g., Gese et al. 2012) there has been little work using camera traps at watering sites to better understand coyote activity patterns or relative abundance. Camera traps at watering sites can document behavioral patterns such as drinking and feeding that radio collars cannot (Atwood et al. 2011, Cove et al. 2012), and camera traps can provide unbiased results when used correctly (Larrucea et al. 2007).

Objectives of this research were to better understand coyote activity at watering sites and find patterns of behavior related to availability of bait, water, air temperature, season, and year. The coyote data were obtained incidental to deer (*Odocoileus hemionus*) and wild pig (*Sus scrofa*) monitoring on typical blue oak rangeland where the primary land use is fee hunting and where coyotes were generally shot on sight. We predicted that coyote activity patterns would be optimized to avoid human exposure, with coyotes being more active at night. We also predicted that coyote water visitation would be affected by physiological need, which should be greatest at high temperatures. We further examined the data to assess the status of coyotes occupying the study area during our investigation.

The Ventana Ranch in southern San Benito County, California (36° 22' N, 120° 55' W) has an area of 1,136 ha and ranges in elevation from 518 m to 1,097 m. The climate is Mediterranean, and characterized by hot dry summers to cool damp winters. Average annual precipitation for the county during our investigation was 23.95 cm (NOAA 2014), with 90% of annual precipitation occurring between November and March. The quality of the soil on the ranch is poor and it does not hold water well. Deer hunting occurs on the property

during August, and pig hunting occurs throughout the year. Habitat types include mixed chaparral, annual and perennial grasslands, and blue oak (*Quercus Douglasii*) woodland.

Camera traps (models RM30, PM35T, and PC 900; RECONYX, Inc. Holmen, Wisconsin 54636) were installed at 17 watering sites on the ranch. Camera traps were placed at a height of about two meters and about four meters away from bait and water. The cameras were set to high sensitivity, no delay, continuous operation, and one photo per trigger, which captured one photo every other second if an animal was in sight and moving. There was a natural or man-made water source provided at or near each site. Bait ("Hog Grower" pellets [16% protein]; Masterfeeds, London, Ontario, Canada]) was replaced approximately monthly when we checked the camera traps.

Camera traps recorded time, date, location, temperature and moon phase for each photo. Data were uploaded to Excel via MAPVIEW (RECONYX, Inc.), and we used Windows Photo Viewer to examine photos individually. We noted if bait was present and if the coyotes fed. We also noted if water was available and if coyotes drank. The duration of each visit was rounded to the nearest minute. A gap of at least six minutes between photos was used as the threshold to define a new visit. If there was only one photo of a coyote representing a visit the duration was recorded as one minute. Coyote activity was expressed as the proportion of total visits detected, or as visits detected per 100 trap-days. We used SYSTAT 13 to calculate mean (±95% CI) visitation rates across the 17 trap locations.

The cameras recorded 1,953 visits by coyotes in 24,530 trap-nights during this investigation (2006–2012). Coyote activity increased at water holes peaking during the middle of the night. At dusk and dawn there was a moderate amount of activity, with minimal activity in the mid-afternoon (Figure 1). Coyotes were most active in October and least active in May. Coyote activity, as recorded by the camera traps, increased in the later months of the year (Figure 2).

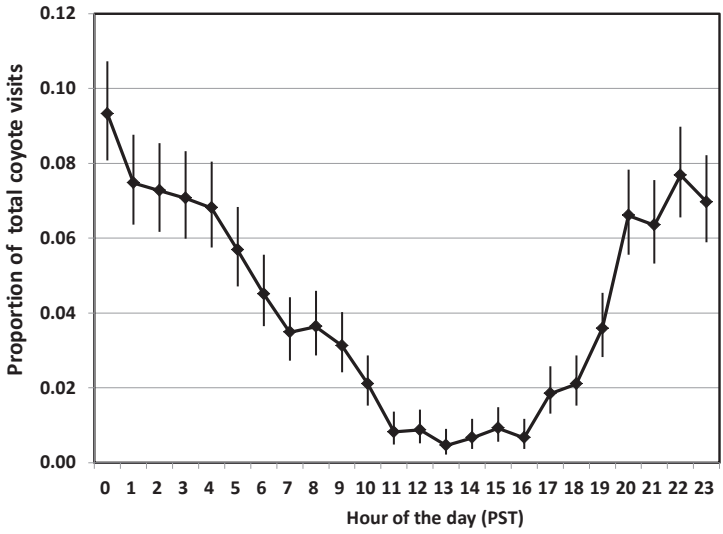

Figure 1.—Diel pattern for coyote visits to water sources at the Ventana Ranch, San Benito County, California, 2006–2012. Camera traps detected 1,953 coyote visits over six years of continuous monitoring. Vertical bars are 95% confidence limits.

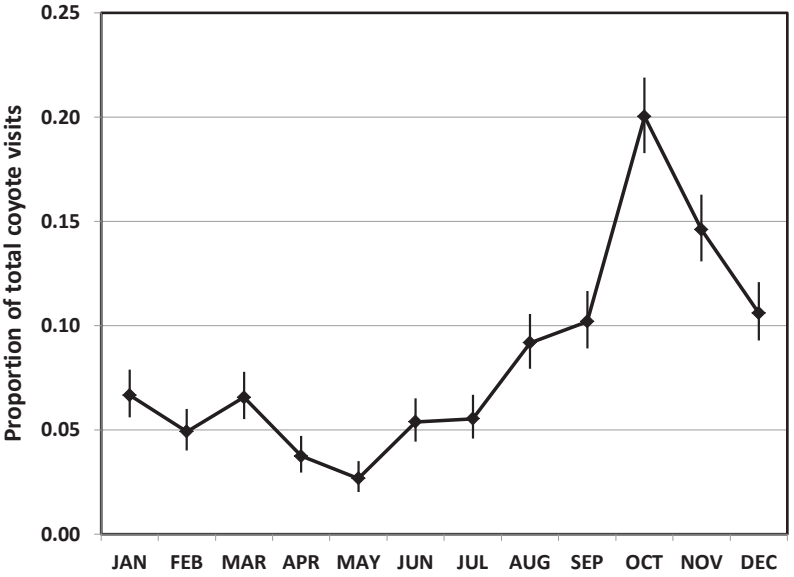

Figure 2.—Seasonal activity pattern for coyotes at the Ventana Ranch, San Benito County, California, 2006–2012. Camera traps detected 1,953 coyote visits to water sources over six years of continuous monitoring. Vertical bars are 95% confidence limits.

Coyotes were recorded drinking available water primarily during the early and late months of the year. Coyotes visited cameras 638 times when water was not available, mainly at two sites where cameras were set on trails leading to water. Of the 1,315 visits when water was in the field of view, coyotes drank ≥218 times (≈17%). Drinking was less frequent in the spring than in the fall. Coyote drinking rate increased as mean monthly temperature increased (Figure 3).

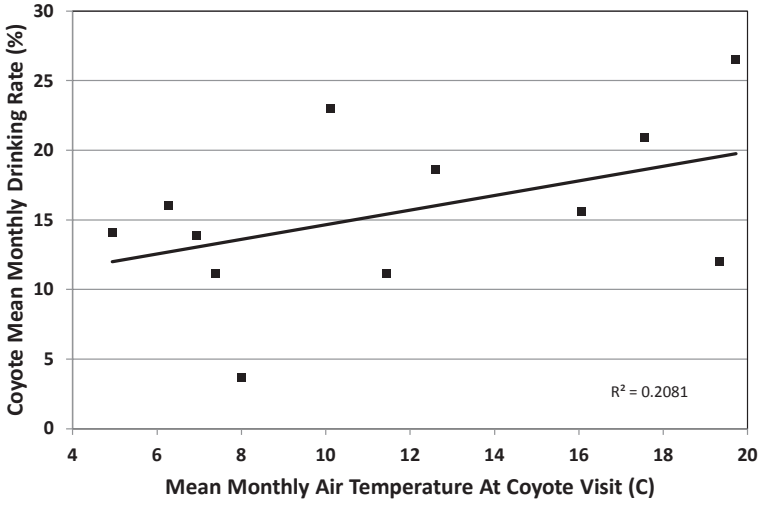

Figure 3.—Coyotes at the Ventana Ranch, San Benito County, California, 2006–2012 tended to drink more often during warmer months; N = 1,953 coyote visits over six years of continuous monitoring.

There was a similar pattern with coyotes feeding on bait; feeding activity was least common in the spring and most common in the fall. Coyotes visited camera traps 1,360 times when bait was not available. Of the 593 visits when it was available, coyotes consumed bait ≥261 times (≈44%).

Cameras recorded 1,679 total visits of one minute or less, the most frequent duration of a visit. The longest visit by an individual coyote was 51 minutes. Duration of visits was greatest when bait was present (Figure 4), and length of visits increased in October and November (Figure 5).

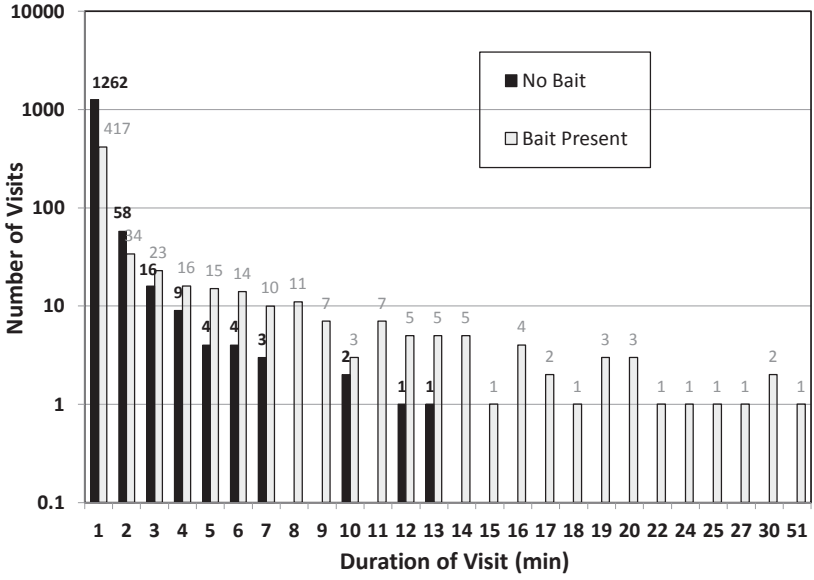

Figure 4.—Coyotes at the Ventana Ranch, San Benito County, California, 2006–2012 tended to spend more time at camera trap sites when bait was present. $N = 1{,}953$ coyote visits over six years of continuous monitoring.

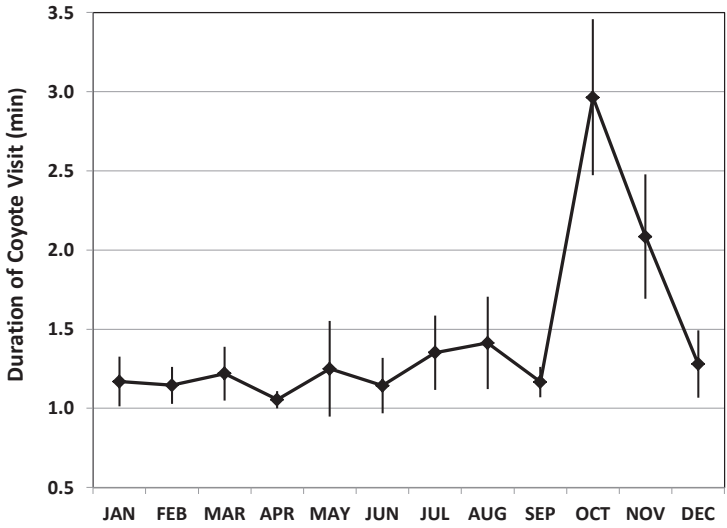

Figure 5.—Coyotes at the Ventana Ranch, San Benito County, California, 2006–2012 tended to spend more time at camera trap sites during the fall dispersal period. $N = 1{,}953$ coyote visits over six years of continuous monitoring. Vertical bars are 95% confidence limits.

There was a decreasing trend of activity in the local coyote population over the six-years of our study. Visits peaked in October of 2007 with 77 visits per 100 camera-trap-nights; during 2012 no more than 10 visits were recorded per 100 camera-trap-nights during any single month (Figure 6).

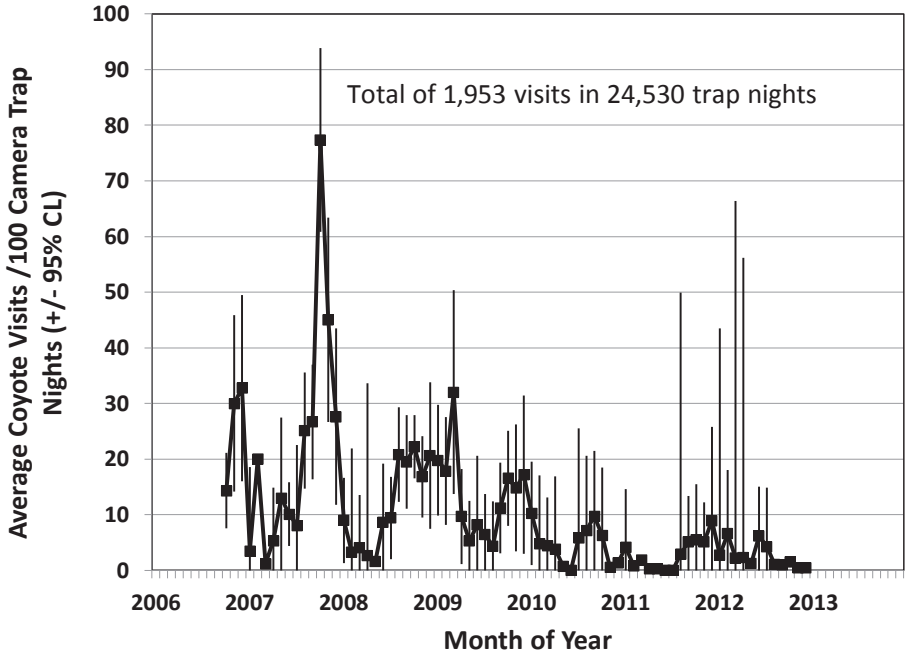

Figure 6.— Coyote detections at the Ventana Ranch, San Benito County, California, 2006–2012 tended to decline over six years of monitoring. Vertical bars are 95% confidence limits.

Our goal was to document coyote activity at watering sites via camera trapping in blue oak woodland habitat. As a result of the small study area, it is likely few coyote territories were sampled. Therefore our results may not, in general, be representative of coyotes occupying blue oak woodlands. Further, our results likely are not representative of non-hunted coyote populations.

Coyote activity primarily was crepuscular. Activity, as recorded by camera traps peaked from September to December, perhaps the result of dispersal of juveniles. Contrary to our predictions, we did not detect a decrease in coyote activity during August and September when deer hunting occurred.

Dispersal of juveniles might explain increased use of bait in the fall and winter; young coyotes becoming independent during those months might be the cause of the increase in feeding on bait designed for pigs. Newly-independent coyotes may be ineffective hunters and visit stationary food sources more often than older animals (Wells and Bekoff 1982). Similarly, newly independent coyotes taking advantage of available water may explain more frequent drinking during fall and winter. Nevertheless, a strong positive relationship existed between drinking rate and mean monthly temperature, thereby confounding this interpretation.

Duration of visits was influenced by the presence or absence of bait at a station. The duration of visits was generally <2 minutes, but visits were longer in the fall and winter months, consistent with the hypothesis that newly independent coyotes might be taking advantage of available bait.

Relative abundance of coyotes at the Ventana Ranch trended strongly downward from 2007 to 2012 as evidenced by annual peaks in visitation rates (Figure 6). That our index to coyote abundance was greatest in 2007, a year following an exceptional acorn crop, was not surprising in that abundant forage may have resulted in an increased prey base and, thereby, had a positive influence on recruitment of pups (Bekoff and Gese 2003). Coyotes were likely having more pups, and a higher proportion of pups were surviving, both of which would increase the number of dispersing juveniles in late summer and early fall of 2007. The following years had poor acorn crops, which could have reduced prey availability and resulted in low pup survival and, thus, fewer visits to camera stations. We speculate that a decline in prey availability, rather than lethal removal, is most likely the reason for the decrease in coyote activity since 2007.

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