

## USE OF NIGHT VISION TECHNOLOGY TO STUDY KIT FOX BEHAVIOR

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The kit fox (*Vulpes macrotis*), which ranges throughout the western United States and northern Mexico, is a nocturnal carnivore and consequently difficult to observe directly (Egoscue 1956). Thus, research on kit fox behavior has focused mainly on data obtained indirectly through radio telemetry, diurnal den watches, and limited observations of captive or trapped foxes. Few investigations have focused on aspects of kit fox biology that require continuous direct observations at night. From September 2002 - March 2003, we employed night vision technology along with radio telemetry to investigate aspects of urban kit fox nocturnal behavior, including scent marking, vocal communication, and behaviors associated with intraspecific and interspecific interactions, by following individual foxes on foot in Bakersfield, California. The use of night vision equipment greatly facilitated collection of data on these and other previously unstudied nocturnal behaviors exhibited by kit foxes.

We employed a commercially available night vision modular pockscope with an ANVIS-style generation III image intensifier tube (model M944, Litton/Northrop Grumman, Garland, Texas) that intensifies low levels of ambient light (visual and infrared) approximately 40,000 times at 68 lp resolution (Koshchavtsev 2001). The night vision scope permitted effective, fine-scale observations of foxes at distances up to approximately 30 m. At distances greater than 30 m, we used a flashlight with an infrared filter for increased illumination or attached an SLR camera lens (28-200 mm) to the monocular body for greater magnification.

We followed 10 adult foxes (5 males/5 females) during our 7-month study using methods described by Altmann (1974) for focal animal sampling, in which we recorded all relevant behaviors for each fox during a specified sample period. We located foxes by VHF telemetry shortly after sunset and followed behind each fox with the night vision scope during active periods. We recorded all behavioral observations verbally in a hand held tape recorder, monitored time by stopwatch, and marked relevant locations by handheld GPS.

The use of night vision allowed us to obtain over 4,800 minutes of cumulative, quantifiable observation time on the kit foxes throughout our study. We directly observed and recorded 1,831 scent marking events, 180 vo-

calizations, and 183 intraspecific and 42 interspecific interactions. We also observed 49 caching events and 2 instances of tree climbing.

Although night vision technology has been employed to study the nocturnal behavior of other canid species, including red fox (*Vulpes vulpes*; Macdonald 1979b), golden jackals (*Canis aureus*; Macdonald 1979a), and Blanford's fox (*Vulpes cana*; Geffen and Macdonald 1993), few investigations into kit fox biology have used night vision technology. In our study, the use of night vision equipment proved highly effective as a research tool that allowed us to document several previously unstudied aspects of behavior in an area where scant information exists on kit fox ecology (Cypher and Warrick 1993).

Although we were able to obtain relatively fine scale observations on kit fox behavior, we found that at greater distances (>30 m) continuous observations of moving foxes were difficult with the attached SLR lens, which narrowed the field of view at high magnification. We also found that urban streetlights and automobile headlights often produced a halo effect, which occasionally hindered observations.

Night vision technology is a versatile, non-invasive tool that may be useful in future kit fox research. Although our investigations involved urban foxes, night vision equipment could be employed in kit fox studies in nonurban environments. For example, the use of night vision equipment could greatly assist in monitoring natal dens to yield more accurate litter counts. Night vision technology could also facilitate investigations into the unstudied nocturnal behaviors of other rare North American carnivores such as island fox (*Urocyon littoralis*), swift fox (*Vulpes velox*), and badger (*Taxidea taxus*).

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