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# LATRINE USE BY SAN JOAQUIN KIT FOXES (*VULPES MACROTIS MUTICA*) AND COYOTES (*CANIS LATRANS*)

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*Key words: latrines, feces, scats, scent marking, chemical communication, kit fox, coyote,* Vulpes macrotis, Canis latrans.

Scent marking with glandular secretions, urine, or feces is common in species of all carnivore families. In general, scent marks are not distributed randomly but are placed carefully on visually conspicuous and often traditionally used objects or locations, such as trail intersections (Macdonald 1985, Gorman and Trowbridge 1989). In some species repeated defecation at the same site results in accumulations of feces (scats) in small areas known as latrines, middens, or spraint piles. Use of latrines is particularly well known in European badgers (*Meles meles;* Stewart et al. 2001, 2002), European otters (*Lutra lutra;* Kruuk 1995), brown hyenas (*Hyaena brunnea;* Gorman and Mills 1984), and spotted hyenas (*Crocuta crocuta;* Mills and Gorman 1987).

Urine marking is generally thought to be the most important form of scent marking in canids (Kleiman 1966), but accumulations of scats in latrines have been described in raccoon dogs (*Nyctereutes procyonoides*), golden jackals (*Canis aureus*), dholes (*Cuon alpinus*), and maned wolves (*Chrysocyon brachyurus;* Macdonald 1985). Ethiopian wolves (*Canis simensis*) tend to concentrate scats at latrines (Sillero-Zubiri 1998) and gray wolves (*Canis lupus*) sometimes defecate near trail junctions (Peters and Mech 1975), which can lead to accumulations of scats that could be considered diffuse latrines (Vila et al. 1994). Some foxes, such as island foxes (*Urocyon littoralis;* Laughrin 1977) and gray foxes (*U. cinereoargenteus;* Trapp 1978) use latrines. However, regular use of latrines has not been described for foxes in the genus *Vulpes,* although the red fox (*V. vulpes*) deposits anal gland secretions on some of its scats (White et al. 1989) in addition to frequent marking with urine (Macdonald 1979).

Scent marking by kit foxes (*V. macrotis*) has not been well described. Egoscue (1962) reported that he found no evidence that kit foxes regularly mark "'sign' stations such as old skeletons or natural objects." O'Farrell (1987) said that kit foxes defecate along trails and near dens and that they mark novel objects by depositing undersized scats on them. He added, "There is no evidence that they systematically mark either their territorial boundaries or 'sign stations' with urine or feces." Recent studies of scent marking by coyotes (*Canis latrans*) in Yellowstone National Park (Gese and Ruff 1997, Allen et al. 1999) concluded that urine marking was the most important form of olfactory communication and that coyotes did not use scats to mark territories.

However, we have observed many accumulations of kit fox scats in latrines while surveying for endangered San Joaquin kit foxes (*V. m. mutica*) at a variety of locations throughout their range (USFWS 1998). We believe that foxes also urinated at these latrines because we often found accumulations of white salts from dried urine and we sometimes found damp soil or small puddles smelling of urine near accumulations of scats in the early morning. We also found coyote scats at some of these latrines. Coyote scats are generally much larger than kit fox scats and also lack the strong, musky odor characteristic of kit fox scats (B. Cypher personal communication).

Here, we provide details on latrines discovered while using trained detection dogs to locate scats of kit foxes in the Lokern Natural Area near Bakersfield, California. It has been demonstrated before that dogs trained to locate scats of target species can provide a successful method of scat recovery (U. Breitenmoser and

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C. Breitenmoser-Wursten, unpublished data, 1984–1994; P. Paquet, unpublished data, 1982–1989; Smith et al. 2001, 2003; Wasser et al. 2004). The principal habitat types in Lokern are nonnative annual grassland, saltbush scrub, and upper Sonoran subshrub scrub. The climate is semiarid with hot, dry summers and cool, wet winters. Approximate summer high and winter low temperatures are 37°C and 1°C, respectively. Average yearly precipitation is 14.5 cm, occurring primarily as winter rains.

We established a transect system on an area approximately 7 $km^2$. Transects ran from north to south and were spaced at 400-m intervals. The entire transect system covered 56 km. To locate scats, a detection dog/handler team systematically searched along each transect (see Smith et al. 2003). We searched the entire transect system in January 2002 and again in January 2003, completing the searches within 5 and 4 days, respectively. We recorded the perpendicular distance in meters from the transect line to each location where a dog found 1 or more scats.

A latrine is a place where 1 or more individuals defecate repeatedly, but there are no standards for how many scats it takes to constitute a latrine. For example, Gorman and Mills (1984) reported that brown hyena latrines contained 5–50 feces, while Begg et al. (2003) decided that 2 feces were enough to constitute a latrine in honey badgers (*Mellivora capensis*). Although 2 fox scats near each other might mark the beginning of a new latrine site, we believe that 2 scats might also be deposited near each other simply by chance or mark a site where 1 fox had encountered a scat of another fox and deposited another in response even though this site was not habitually visited. Because of these considerations, we defined a latrine as an accumulation of at least 3 kit fox scats. We recorded whether fox scats were found alone or in a latrine and whether they were located on or near a conspicuous object. In 2003 we also recorded how many fox and coyote scats were present at most latrines used by both species.

We found kit fox scats at 161 locations in 2002. Eighty-nine locations had only 1 scat, 11 had 2, and 61 had 3 or more, thus meeting our definition of a latrine. Latrines were rarely located near fox dens: only 2 of the 61 latrines were near dens. Seven of the 61 latrines marked a conspicuous object (1 cement object, 1 tire, 1 bottle, 1 sheep carcass, 1 coyote skull, and 2 pieces of bone). Ten of the 61 contained coyote scats in addition to fox scats. We also found 2 latrines containing only coyote scats.

We found kit fox scats at 98 locations in 2003. Forty-nine locations had only 1 scat, 17 had 2, and 32 had 3 or more. Eight of the 32 latrines marked a conspicuous object (1 metal object, 1 tire, 1 can, 1 fencepost, and 4 powerline poles). Four of the latrines also contained coyote scats. Three of these contained 23 fox and 3 coyote scats, 6 fox and 6 coyote scats, and 20 fox and 3 coyote scats, respectively. We also found 1 latrine containing only coyote scats. Although only about one-third (32/93) of the locations where scats were found were latrines, latrines contained over 75% (242/315) of the 315 fox scats we found. The largest number of kit fox scats we found at the 26 latrines where we counted the number of scats present was 30 (Fig. 1).

We measured distance from the transect line for all but 2 of the locations where scats were found in 2002 (159) and all locations in 2003 (98). As distance from the transect was independent of year (2-tailed $t$ test, $t = 1.510$, df $=255$, $P = 0.132$), we pooled data for both years, yielding a sample of 257 locations. Scats were found at a minimum distance of 0 m from the transect and at a maximum of 38.40 m. The mean distance was $4.8 \pm 6.7$ m ($s$).

Accumulations of multiple scats might have a stronger smell than a single scat, making it easier for dogs to detect latrines than single scats. We reasoned that, if this hypothesis were true, latrines would, on average, be found at greater distances from the transect line than single scats. The mean distance for single scats was $4.3 \pm 6.3$ m and that for latrines was $5.9 \pm 7.3$, but there was no significant difference in the distances recorded for single scats and latrines (2-tailed $t$ test, $t = 1.801$, df $= 238$, $P = 0.07$).

In urban Bakersfield, where coyotes are rare (B. Cypher personal communication), we observed that kit foxes use latrines even when no coyotes are present. Therefore, use of latrines appears to be a typical feature of kit fox biology. Although the functions of these kit fox latrines are not known, they likely play some role in chemical communication. In several carnivore species where latrine use has been well studied, such as badgers (Stewart et al. 2001, 2002) and hyenas (Gorman and Mills

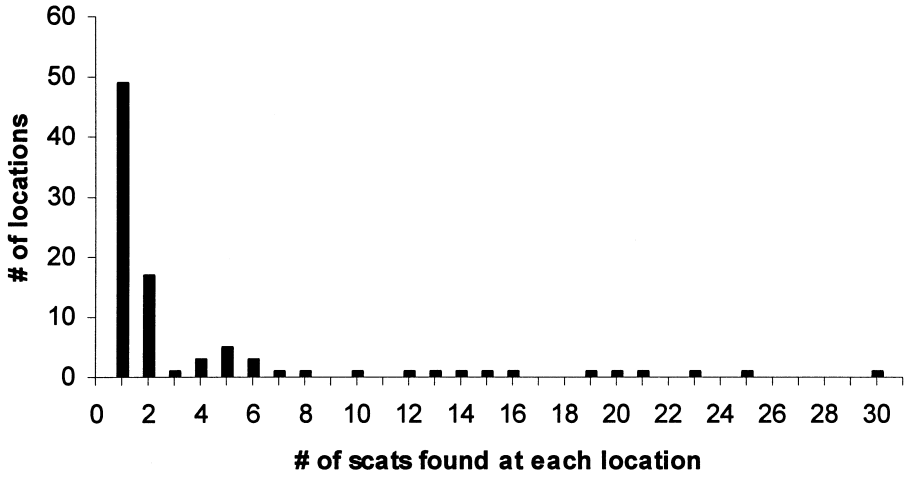


Fig. 1. Number of locations at which various numbers of kit fox scats were found in the Lokern Natural Area in 2003.

1984, Mills and Gorman 1987), latrines serve to mark the territories of the resident social group.

Coyotes are known to urinate over places where wolves have urinated (Paquet 1991). If they tend to urinate and defecate on kit fox scats, this would lead to the accumulation of coyote scats at some kit fox latrines. However, we found 3 latrines that contained only coyote scats, indicating that coyotes use latrines on our study area even if no kit fox scats are present. Thus, it is not clear whether joint latrines result from coyotes responding to kit fox scats, kit foxes responding to coyote scats, or both.

If we had trained dogs to locate coyote scats rather than kit fox scats and had searched a larger geographic area, we likely would have found more latrines that contained only coyote scats. Although several detailed studies of scent marking in coyotes do not mention latrine use (Bowen and Cowan 1980, Wells and Bekoff 1981, Bekoff and Wells 1986, Gese and Ruff 1997, Allen et al. 1999), Camenzind (1978) mentions 2 coyote latrines discovered in Wyoming. One was in an empty hay shed and contained over 500 scats. The second, under an old wooden bridge crossing a dry creek, also contained several hundred scats. Both latrines were in inconspicuous, covered areas and Camenzind (1978) did not think that they "served territorial functions." However, it seems likely that coyotes do use accumulations of scats for chemical communication under some circumstances, as in the example Brattstrom (1999) described with piles of feces left by coyotes on a footpath to mark the entrances of descending trails through thick brush in coastal California.

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## LITERATURE CITED

ALLEN, J.J., M. BEKOFF, AND R.L. CRABTREE. 1999. An observational study of coyote (*Canis latrans*) scent-marking and territoriality in Yellowstone National Park. Ethology 105:289–302.

BEKOFF, M., AND M.C. WELLS. 1986. Social ecology and behavior of coyotes. Advances in the Study of Behavior 16:251–238.

BEGG, C.M., J. BEGG, T. DU TOIT, AND M.G.L. MILLS. 2003. Scent-marking behaviour of the honey badger, *Mellivora capensis* (Mustelidae), in the southern Kalahari. Animal Behaviour 66:917–929.

BOWEN, W.D., AND I.M. COWAN. 1980. Scent marking in coyotes. Canadian Journal of Zoology 58:473–480.

BRATTSTROM, B.H. 1999. Trail marking by coyotes, *Canis latrans*. Southwestern Naturalist 44:405–406.

CAMENZIND, F.J. 1978. Behavioral ecology of coyotes on the National Elk Refuge, Jackson, Wyoming. Pages 267–294 *in* M. Bekoff, editor, Coyotes: biology, behavior, and management. Academic Press, New York.

EGOSCUE, H.J. 1962. Ecology and life history of the kit fox in Tooele County, Utah. Ecology 43:481–497.

GESE, E.M., AND R.L. RUFF. 1997. Scent marking by coyotes, *Canis latrans:* the influence of social and ecological factors. Animal Behavior 54:1155–1166.

GORMAN, M.L., AND M.G.L. MILLS. 1984. Scent marking strategies in hyenas (Mammalia). Journal of Zoology 202:535–537.

GORMAN, M., AND B.J. TROWBRIDGE. 1989. The role of odor in the social lives of carnivores. Pages 57–88 *in* J.L. Gittleman, editor, Carnivore behavior, ecology, and evolution. Cornell University Press, Ithaca, New York.

KLEIMAN, D. 1966. Scent marking in the Canidae. Symposia of Zoological Society of London 18:66–167.

KRUUK, H. 1995. Wild otters: predation and populations. Oxford University Press, Oxford, UK.

LAUGHRIN, L.L. 1977. The island fox: a field study of its behavior and ecology. Doctoral dissertation, University of California, Santa Barbara.

MACDONALD, D.W. 1979. Some observations and field experiments on the urine marking behavior of the red fox, *Vulpes vulpes* L. Zeitschrift für Tierpsychologie 51:1–22.

_____. 1985. The carnivores: order Carnivora. Pages 619–722 *in* R.E. Brown and D.W. Macdonald, editors, Social odors in mammals. Clarendon Press, Oxford, UK.

MILLS, M.G.L., AND M.L. GORMAN. 1987. The scent-marking behavior of the spotted hyaena, *Crocuta crocuta,* in the southern Kalahari. Journal of Zoology 212:483–497.

O'FARRELL, T.P. 1987. Kit fox. Pages 423–431 *in* M. Novak, J.A. Baker, M.E. Obbard, and B. Malloch, editors, Wild furbearer management and conservation in North America. Ministry of Natural Resources, Ontario, Canada.

PAQUET, P.C. 1991. Scent-marking behavior of sympatric wolves (*Canis lupus*) and coyotes (*C. latrans*) in Riding Mountain National Park. Canadian Journal of Zoology 69:1721–1727.

PETERS, R.P., AND L.D. MECH. 1975. Scent-marking in wolves. American Scientist 63:628–637.

SILLERO-ZUBIRI, C., AND D.W. MACDONALD. 1998. Scent-marking and territorial behavior in Ethiopian wolves (*Canis simensis*). Journal of Zoology 245:351–361.

SMITH, D., K. RALLS, B. DAVENPORT, B. ADAMS, AND J. MALDONADO. 2001. Canine assistants for conservationists. Science 291:435.

SMITH, D.A., K. RALLS, A. HURT, B. ADAMS, M. PARKER, B. DAVENPORT, M.C. SMITH, AND J.E. MALDONADO. 2003. Detection and accuracy rates of dogs trained to find scats of San Joaquin kit foxes (*Vulpes macrotis mutica*). Animal Conservation 6:339–346.

STEWART, P.D., D.W. MACDONALD, C. NEWMAN, AND C.L. CHEESEMAN. 2001. Boundary faeces and matched advertisement in the European badger (*Meles meles*): a potential role in range exclusion. Journal of Zoology, London 255:191–198.

STEWART, P.D., D.W. MACDONALD, C. NEWMAN, AND F.H. TATTERSALL. 2002. Behavioral mechanisms of information transmission and reception by badgers, *Meles meles,* at latrines. Animal Behaviour 63:999–1007.

TRAPP, G.R. 1978. Comparative behavioral ecology of the ringtail (*Bassariscus astutus*) and gray fox (*Urocyon cinereoargenteus*) in Southwestern Utah. Carnivore 1:3–32.

U.S. FISH AND WILDLIFE SERVICE. 1998. Recovery plan for upland species of the San Joaquin Valley, California. Region 1, Portland, OR. 319 pp.

VILA, C., V. URIOS, AND J. CASTROVIEJO. 1994. Use of faeces for scent marking in Iberian wolves (*Canis lupus*). Canadian Journal of Zoology 72:374–377.

WASSER, S.K., B. DAVENPORT, E.R. RAMAGE, K.E. HUNT, M. PARKER, C. CLARKE, AND G. STENHOUSE. 2004. Scat detection dogs in wildlife research and management: application to grizzly and black bears in the Yellowhead Ecosystem, Alberta, Canada. Canadian Journal of Zoology 82:475–492.

WELLS, M.C., AND M. BEKOFF. 1981. An observational study of scent marking in coyotes, *Canis latrans.* Animal Behaviour 39:332–350.

WHITE, P.J., T.J. KREEGER, J.R. TESTER, AND U.S. SEAL. 1989. Anal-sac secretions deposited with feces by captive red foxes (*Vulpes vulpes*). Journal of Mammalogy 70:814–816.

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