

RESPONSES OF SAN JOAQUIN KIT FOXES TO AN OIL-GAS WELL FIRE

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Well blowouts are rare, but they have the potential to affect local wildlife in oil producing areas (Odu 1972, Freedman 1995). A blowout is defined as the uncontrolled flow of natural gas, petroleum, or water from a well bore (Freedman 1995). Well blowout impacts on upland species have been reported before (Warrick et al. 1997), but more information is necessary to further understand the potential effects of oil-gas extraction on wildlife.

Here I describe the movements of four endangered San Joaquin kit foxes, *Vulpes macrotis mutica*, before and after a well blowout. Other risks in oilfield environments include the potential presence of hydrogen sulfide gas in kit fox dens (Spiegel and Dao 1997), an increase in concentrations of Zn, Cu, and Cd in kit fox tissues (Charlton et al. 2001), and oilfield-related mortalities such as exposure to toxic chemicals (e.g., arsenic) and kit foxes being covered in oil (Cypher et al. 2000). The San Joaquin kit fox was listed as endangered by the U.S. Department of the Interior in 1967 and as threatened by the State of California in 1971 (U.S. Fish and Wildlife Service 1998¹).

Well blowouts and fires have occurred in San Joaquin kit fox habitat before: 1994 well blowout on Naval Petroleum Reserve No. 1 (Warrick et al. 1997); Elk Hills well fire of 1977 (R. Hauser, Department of Conservation, Division of Oil, Gas, and Geothermal Resources, pers. comm.); however, no information was gathered on kit fox behavior. There have been 16 gas or oil blowouts since 1990 in Kern County, California; they lasted a few hours to a few days and did not result in fires (R. Hauser, pers. comm.), too short for a study on blowout effects on kit foxes.

The Bellevue East Lost Hills No. 1 (17-26S-21E) oil-gas well fire provided an opportunity to observe kit fox reaction to the incident. The oil-gas well was located ~300 m east of the California Aqueduct (aqueduct), in a 1200-ha cotton field near Lost Hills, Kern County, California (35.6°N, 119.7°W). The well blew out at approximately 20:00 hrs on 23 November 1998. It burned for 15 days, blew steam and minute oil droplets for 6 days, was intentionally re-lit, and then burned for another 6 months. Potential disturbance during the entire 6-month period included a roaring noise from escaping gas, intense heat and light from the fire, smoke and toxic fumes, ground vibration, and increased vehicular and human activity.

Since May 1997, San Joaquin kit foxes have been radio-collared and monitored from one to four times a week along a 24-km stretch of the aqueduct between Lerdo

¹U.S. Fish and Wildlife Service. 1998. Recovery plan for upland species of the San Joaquin Valley, California. Region 1, Portland, Oregon. 319 pp.

Highway north to the Kern County line for an agricultural land use study. Foxes were radio-tracked using two truck-mounted null tracking systems with paired 2-element antennae (Kenward 1987). Stations were located along access roads of the aqueduct and separated by approximately 800 m. After setup and calibration of the systems, researchers at two adjacent stations simultaneously took bearings on radio-collared kit foxes (Mech 1983).

A telemetry session was initiated approximately 1 h before sunset and continued for approximately 4 h. The first 3-5 h after sunset is typically when kit and swift fox activity is highest (Cypher et al. 2000). Locations were collected on all collared foxes in the vicinity and successive locations on individual foxes were separated by ~10 min. Home range data on these foxes were collected from May 1997 until the fox experienced mortality. Behavioral observations reported here were made during November 1998 (pre-blowout) and in December 1998 (post-blowout).

Before the blowout, two radio-collared kit foxes were active near the well and two were not. All four kit foxes had linear shaped home ranges, closely associated with the aqueduct corridor based on 1.5 yrs of telemetric locations. The foxes normally used the aqueduct right-of-way and an earthen berm 4 m in height (paralleling the aqueduct) as a travel corridor within their home ranges. Foraging in the adjacent agricultural fields occurred frequently but was not observed at distances >700 m from the aqueduct.

An adult male kit fox (M1) used a home range 10 km south of the oil-gas well site. On the evening of the well explosion (23 November 1998), he traveled along the aqueduct right-of-way to an area 3.5 km north of the well site. This was the first time he was found in that area. After November 23, he stayed in this area, with his home range overlapping a female kit fox (F1) in the study area. She used an area extending from 5 to 10 km north of the well site. She remained in this home range both before and after the well fire.

Prior to the blowout an adult female kit fox (F2) had a home range that extended from the well to 5 km north of the well site. After the fire, her southern home range boundary extended south another 2 km and she continued to use the northern portion of her range. She was found dead 1.6 km south of the well site along the aqueduct on 7 December 1998. This fox was killed by a red fox, *V. vulpes*, but was not eaten.

The fourth kit fox, an adult male (M2), also ranged in this area. Prior to the well fire, his home range overlapped the home ranges of the two females, F1 and F2 and extended from 1 km south to 6 km north of the well site. After the fire, he abandoned his northern range area, and remained in the southern portion of his range, shifting an additional 1 km to the south. He was found 300 m to the west of the well on two occasions and 600 m northwest of the site on one occasion. He was killed by a coyote, *Canis latrans*, and found dead on 23 December 1998, 13 km north of the well.

Although there were too few data to quantitatively analyze during the blowout period, it appears from visual and telemetric observations that the impact of the gas-well fire on these four kit foxes was minimal. Kit foxes F1 and M1 were the least affected. F1 maintained the same home range throughout the incident, and pair-bonded with M1 upon his arrival to her range area. M1 moved through the area of the

well fire most likely by using the 4-m berm as a corridor and heat-noise barrier. Male kit foxes usually join the females at natal dens in October or November and breeding occurs during December or January (McGrew 1979). M1 and F1 had a litter of three male kits in February 1999, consistent with the hypothesis that M1's movements were of a pair-bonding nature, and not necessarily a reaction to the well fire.

Kit fox F2 shifted her range to the south of the well site. M2 may have formed a pair bond with F2 because he shifted his range south as well, overlapping her new area. However, F2 was attacked and killed by a red fox. Subsequently, M2 moved 13 km to the north into unknown territory and was killed by a coyote.

Although an oil-gas well burned nearby, the female foxes continued with their behavioral activities and did not move out of their range areas. The male foxes did have large movements, but it is believed they are related to breeding season behaviors (McGrew 1979, Zoellick et al. 1989, 2002), rather than a well fire reaction.

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