SAN JOAQUIN KIT FOX DISTRIBUTION AND ABUNDANCE IN 1975[1/]

by

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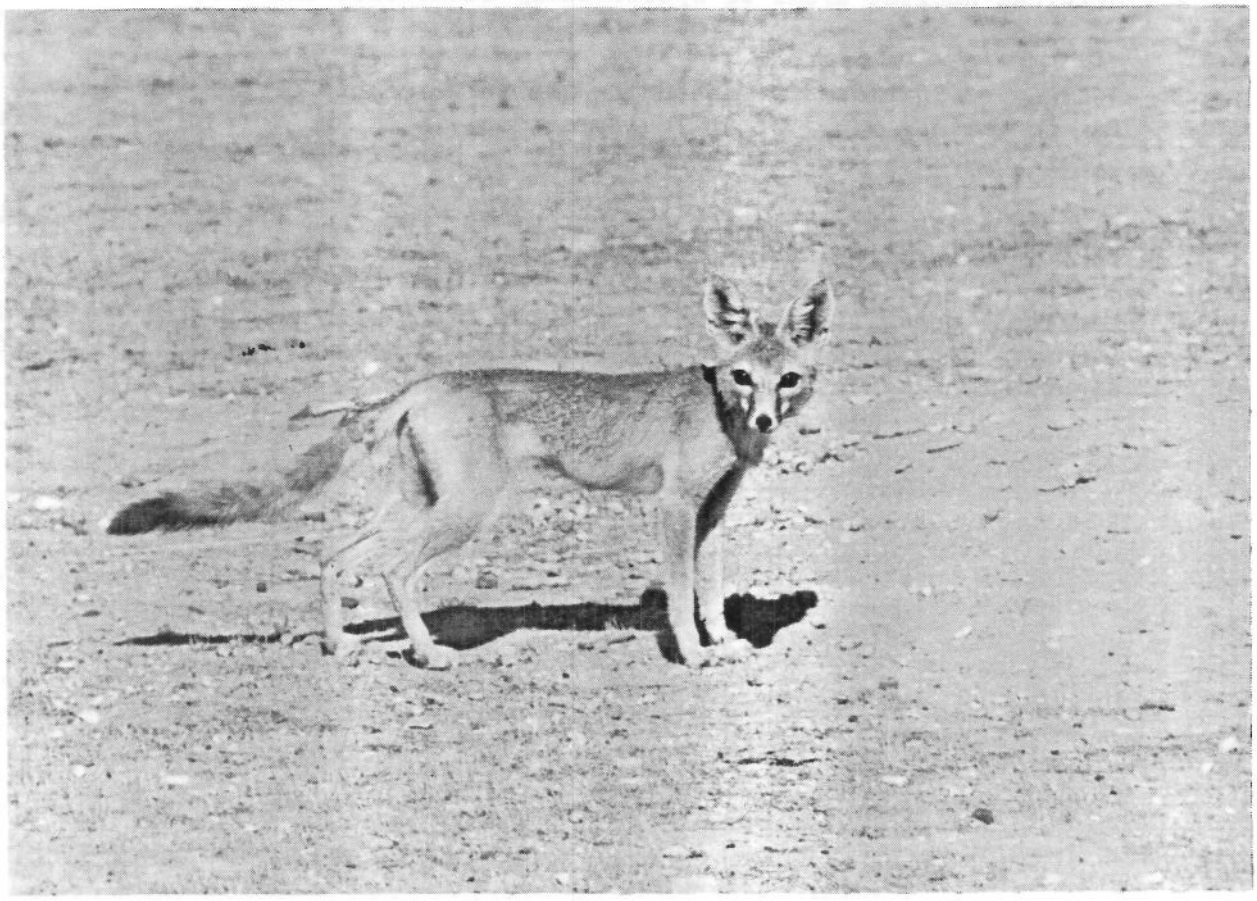


ABSTRACT

Presence of the San Joaquin kit fox (Vulpes macrotis mutica) has been confirmed in 14 counties of California, and an updated range map for the species has been prepared. The population is estimated to be 10,000 adult animals with a maximum of 14,800 adults. Critical habitat areas were identified. Recommendations to ensure survival of the San Joaquin kit fox have been incorporated in this report.

1/ In fulfillment of contracts W-54-R-7-1 with the California Department of Fish and Game and U. S. Fish and Wildlife Service and 3904 with the California Department of Food and Agriculture. Calif. Dept. Fish and Game, Wildlife Mgmt. Br. Admin. Rept. No. 75-3 (October 1975).

RECOMMENDATIONS

Based on the findings of this study, it is recommended that:

1. A San Joaquin Kit Fox Recovery Team immediately develop and implement a recovery plan.

2. Critical habitat areas be specifically identified and measures be taken to assure their preservation.

3. A study be initiated to determine the relationship of the San Joaquin kit fox to various types of agricultural activities and to establish guidelines to maintain kit fox populations in agricultural areas.

4. Night hunting be prohibited throughout the range of the San Joaquin kit fox.

5. Continual surveillance of kit fox populations be made through aerial den surveys, spotlight surveys, and solicited reports of San Joaquin kit fox sightings.

INTRODUCTION

As greater amounts of irrigation water have been made available throughout the San Joaquin Valley by the California State Water Project, uncultivated acreage has diminished. Laughrin (1970) estimated a 34 percent reduction in native habitat from 1959 to 1969 within the area he considered kit fox range. Jensen (1972) determined that 113,800 acres (178 square miles) of natural habitat in Kern County alone were converted to irrigated cropland from 1968 to 1971. Department of Water Resources land use surveys of 5,098,000 acres on the San Joaquin Valley floor in Kern, Kings, Fresno, and Tulare counties show a loss of 490,000 acres of native vegetation between 1958 and 1970 (Table I).

TABLE I. Land Use Change in Four San Joaquin Valley Counties[1/]

County	Year	Urban (Acres)	Irrigated Crops (Acres)	Nonirrigated Crops (Acres)	Native Vegetation (Acres)	Total (Acres)
Kern	1958	35,142	622,048	49,006	889,184	---
	1970	36,609	747,913	40,746	770,112	1,595,380
Kings	1958	7,411	413,184	19,807	410,987	---
	1970	11,390	525,928	15,293	298,778	851,389
Fresno	1958	35,143	1,063,504	27,200	477,624	---
	1970	59,736	1,238,008	14,663	291,064	1,603,471
Tulare	1958	---	625,497	53,450	369,598	---
	1970	---	701,616	50,031	296,898	1,048,545
TOTALS	1958	77,696	2,724,233	149,463	2,147,393	---
	1970	107,735	3,213,465	120,733	1,656,852	5,098,785

1/ Department of Water Resources Land Use Surveys

Land conversion from uncultivated natural habitat to agriculture, industrial, and urban developments has been especially rapid in the last five years. Completion of two major construction projects--the California Aqueduct and Interstate Highway 5--has contributed in large part to the reduction of natural habitat. Figures I-III illustrate the land use changes which occurred since 1920 within current kit fox range.

Loss of habitat has resulted in a decrease in the populations of many animal and plant species associated with the "native" Alkali Sink Plant Community (Munz-1965), formerly the dominant community on the floor of the southern portion of the San Joaquin Valley. The San Joaquin kit fox (Vulpes macrotis

mutica) is one of the animals affected by such habitat loss. In addition to loss of habitat, the San Joaquin kit fox was until recently under considerable pressure from shooting. A decline of the San Joaquin kit fox was noted by field personnel in both federal and state wildlife agencies, and the plight of the kit fox was called to the attention of the California Department of Fish and Game and the U. S. Fish and Wildlife Service in the 1950's and 1960's.

In 1965, the California Fish and Game Commission responded by declaring both the San Joaquin kit fox and desert kit fox (V. m. arsipus) protected furbearers. The Secretary of the Interior acted in 1966, designating the San Joaquin kit fox an endangered species under the federal Endangered Species Preservation Act of 1966.

U. S. Fish and Wildlife Service, Division of Wildlife Services personnel began keeping records of San Joaquin kit fox den locations in 1962 in conjunction with their other field work. In 1965, Grant Birmingham, U. S. Fish and Wildlife Service, initiated an annual kit fox den survey on 15-20 square miles of kit fox habitat in southern Kings and southwestern Tulare counties. The den survey was continued on the ground in the same areas until 1972, at which time the areas were searched for kit fox dens from the air.

Riley Patterson, U. S. Fish and Wildlife Service, initiated a similar comprehensive kit fox den survey with the aid of his district field assistants in 1969. The survey team covered approximately 140,000 acres of prime San Joaquin kit fox habitat in Kern County (Laughrin-1970). The den survey was repeated in the same areas in 1970 and 1971. An average of 0.81 active kit fox dens per square mile was obtained by Patterson and his assistants over the three year period (Waithman-1974a). In 1972 and 1973, the same areas were searched from a low flying aircraft. The averages for those two years were, respectively, 1.78 and 0.29 active dens per square mile (Waithman-1974a).

The first extensive survey of the distribution and abundance of the San Joaquin kit fox was initiated in 1969 by Lyndal Laughrin for the California Department of Fish and Game, Special Wildlife Investigations. The results of that survey, including recommendations for subsequent studies, were published by the Department of Fish and Game in 1970 as an administrative report. Laughrin (1970) estimated the size of the San Joaquin kit fox population as between 1,000 and 3,000 individuals, based upon population density estimates of from one adult fox per 2.8 square miles to one adult fox per square mile and a suitable habitat estimate of 3,000 square miles.

A life history study of the San Joaquin kit fox was undertaken by Stephen Morrell for the California Department of Fish and Game in 1970. In addition to Special Wildlife Investigations, the Pesticides Investigations section of the Department of Fish and Game and the U. S. Fish and Wildlife Service became interested and involved in the study. The involvement of Pesticides Investigations and U. S. Fish and Wildlife Service reflected concern over the possibility that rodent control activities, especially Beechey ground squirrel (Spermophilus beecheyi) control using compound 1080 (Sodium monofluoroacetate), within kit fox range might be having an adverse effect upon the kit fox through secondary poisoning.

The 15-month life history study was conducted in Buena Vista Valley, on and adjacent to the Elk Hills Naval Petroleum Reserve near Taft in Kern County. Radio telemetry was used to facilitate data collection. Data were gathered on denning, food habits, reproduction, and behavior. The kit fox population density in the two square mile study area was six adults per square mile (Morrell-1971, 1972). Results of the study were published by the Department of Fish and Game in 1971 as an administrative report and in 1972 in California Fish and Game. These life history data, collected on a kit fox population not exposed to rodent control activity, were to serve for comparison to data collected during a second study of a kit fox population which was exposed to rodent control using compound 1080 treated grain bait. The second study was not done.

In 1971, on the basis of the Department's findings, the California Fish and Game Commission declared the San Joaquin kit fox a rare species under the California Endangered Species Act of 1970. State law prohibits take or possession of rare or endangered species without proper permit.

In 1972, the California Fish and Game Commission closed portions of Kern, San Luis Obispo, Fresno, Kings, and Monterey counties to all night hunting and furbearer trapping after it was determined that illegal shooting of the San Joaquin kit fox was taking a significant toll (Morrell-1971, 1972). The area closed to night hunting was enlarged to the area shown in Figure IV. Appended is a legal description of the area presently closed to night hunting (Exhibit I).

Charles Jensen was employed by the U. S. Fish and Wildlife Service in 1972 to update the San Joaquin kit fox distribution map prepared by Laughrin in 1969. Jensen's study, published in 1972 as an administrative report by the U. S. Fish and Wildlife Service, resulted in an extension of the known range of the San Joaquin kit fox into Monterey County and north into Contra Costa County.

While Jensen's work confirmed the presence of the San Joaquin kit fox in Contra Costa and San Joaquin counties, distribution of the animals within those counties was still unknown as Jensen was limited by funding. Craig Swick was assigned by the California Department of Fish and Game in 1973 to determine the locations of San Joaquin kit fox within Contra Costa, Alameda, San Joaquin, and Tulare counties. This he was able to accomplish with the cooperation and assistance of the County Agricultural Commissioners' offices.

Also in 1973, the California Department of Fish and Game and California Department of Food and Agriculture monitored the effect of an aerial application of compound 1080 treated grain bait for ground squirrel control. The work was done in San Luis Obispo County with the cooperation and assistance of the San Luis Obispo County Agricultural Commissioner's office. Prior to the ground squirrel control operation, five adult kit fox in the area were fitted with radio telemetry collars. The movements of those five animals, three in treatment areas and two in a nontreatment area, were monitored before and after aerial application of compound 1080 treated grain bait (Swick-1973b).

Nine kit fox (4 adults, 5 pups) were within 0.5 mile of compound 1080 treated areas. No impact on those kit fox from ground squirrel control measures was observed during the program (Swick-1973b).

The kit fox distribution studies conducted by Laughrin, Jensen, and Swick were all of short duration (several months each). Because of the large area inhabited by the San Joaquin kit fox and the limitations of time and funding placed upon the researchers, each of the three studies was followed by reports of kit fox occurrence outside of the range described. In addition, questions were raised about the San Joaquin kit fox relative to population size, mortality factors, and possible protective measures. All of these elements resulted in a decision by the California Department of Fish and Game, California Department of Food and Agriculture, and U. S. Fish and Wildlife Service to jointly fund a 12-month study to determine the distribution, abundance, and status of the San Joaquin kit fox. This study was directed to redefining the range and documenting the locations of kit fox. Appended Figure IA shows the range boundary determined in the 1974-75 study and the locations of kit fox sightings and dens.

The study commenced in March, 1974. A second person, John Waithman, was employed by the U. S. Fish and Wildlife Service for four months to design and conduct an aerial census of the San Joaquin kit fox population. Results of that census, which replaced the ground and air searches previously conducted under Riley Patterson, were published as an administrative report by the U. S. Fish and Wildlife Service in 1974. A separate report summarizing the first four months of the kit fox distribution study was prepared by Waithman and also published as an administrative report by the U. S. Fish and Wildlife Service in 1974.

This 12-month study was conducted from March through September 1974 and from March through July 1975. Results of the study are presented in the following report.

METHODS

Aerial Den Survey

Two aerial den surveys were conducted during this study. The first survey, designed and directed by John Waithman, was conducted during the first week of April 1974. The second survey was conducted during the fourth week of April 1975 in a manner identical to that used in 1974, except for a difference in altitude and personnel in the aircraft. Both surveys were designed to collect data to use as the basis for a population estimate of the San Joaquin kit fox. All kit fox den surveys, whether aerial or ground (as conducted by Birmingham and Patterson), were made in the spring. Occupied kit fox dens are most apparent at that season due to fresh digging by adult animals and leveling of grass at the den site by pup activity outside (Morrell-1971, 1972).

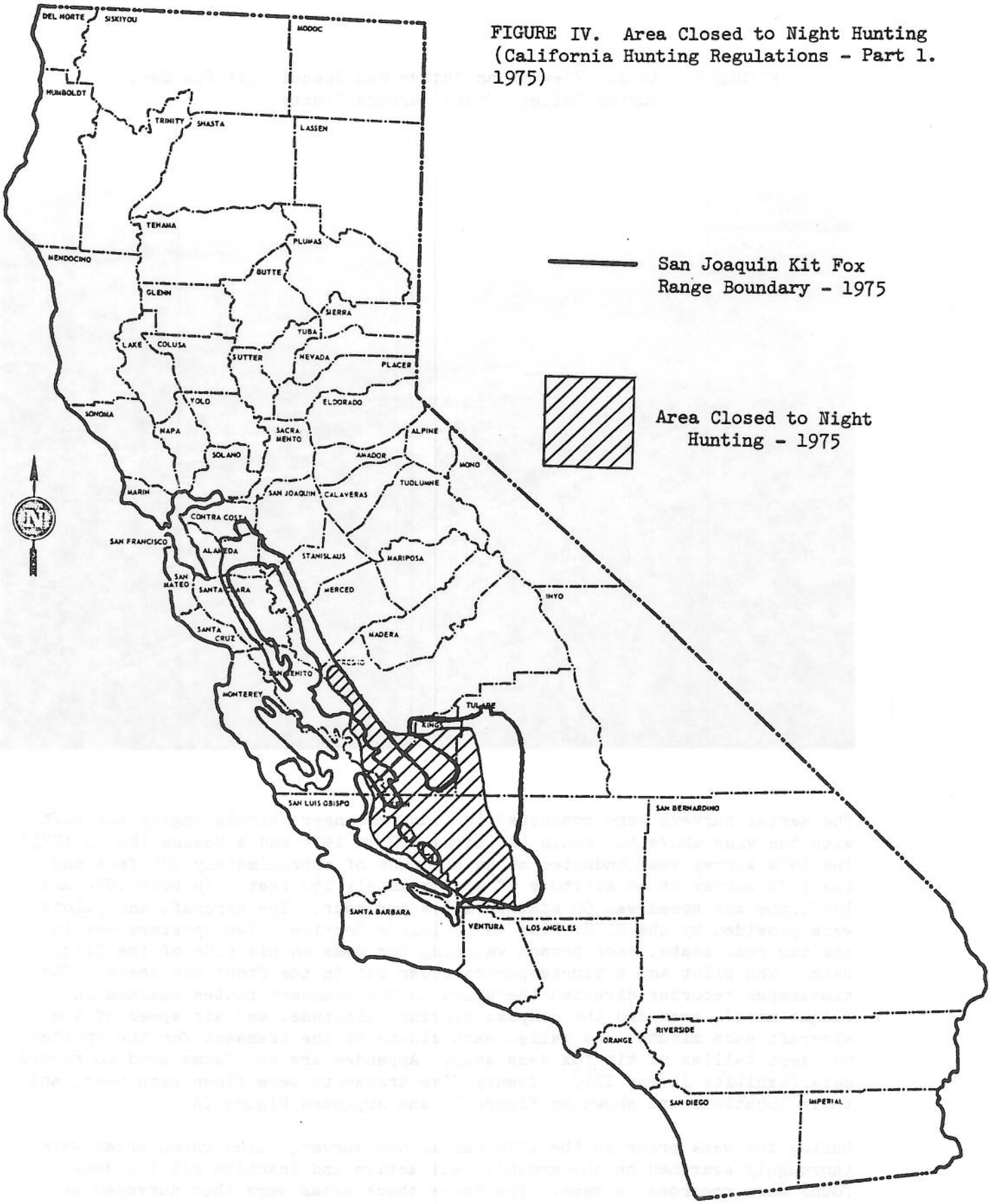
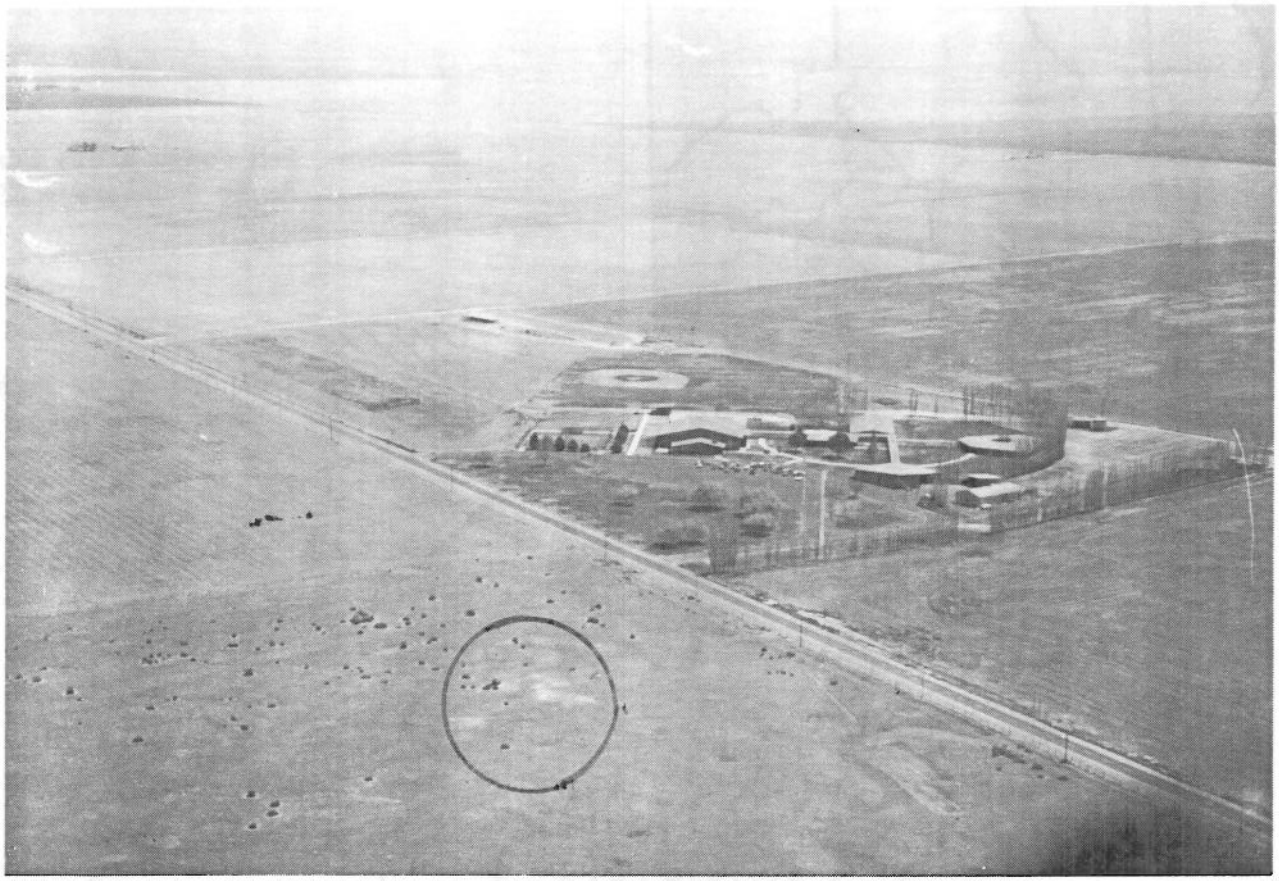


FIGURE IV. Area Closed to Night Hunting (California Hunting Regulations - Part 1. 1975)

FIGURE V. Aerial View of an Active San Joaquin Kit Fox Den, Cuyama Valley, Santa Barbara County.



The aerial surveys were conducted in four-passenger, single engine aircraft with the wing above the cabin (a Cessna 182 in 1974 and a Cessna 185 in 1975). The 1974 survey was conducted at an altitude of approximately 300 feet and the 1975 survey at an altitude of approximately 150 feet. In both 1974 and 1975, the air speed was 90 statute miles per hour. The aircraft and pilots were provided by the U. S. Fish and Wildlife Service. Two spotters sat in the two rear seats, each person watching for dens on his side of the flight path. The pilot and a timekeeper-recorder sat in the front two seats. The timekeeper-recorder directed the pilot to the transect routes (marked on flight maps), recorded the compass bearing, altitude, and air speed of the aircraft each minute, and called each minute of the transect for the spotters who kept tallies of kit fox dens seen. Appended are the forms used to record data (Exhibits II and III). Twenty-five transects were flown each year, and their locations are shown on Figure VI and appended Figure IA.

During the week prior to the 1974 aerial den survey, three check areas were thoroughly searched on the ground. All active and inactive kit fox dens found were recorded on maps. The three check areas were then surveyed as part of the aerial den survey. In this manner, the accuracy with which

FIGURE VI. Den Survey Transects
1974-75

kit fox dens could be located and inactive dens could be distinguished from active dens from the air was determined.

Remote Sensing

A kit fox den census method utilizing high altitude photography was designed by David Adams, Remote Sensing Specialist for the California Department of Food and Agriculture. It was tried on an experimental basis over a small area in the spring of 1975 by National Aeronautics and Space Administration's Ames Research Center. Prior to the photography session, five kit fox dens (3 active and 2 inactive) were marked on the ground with 3' by 4' pieces of white plastic so that known dens could be located on the transparencies for reference. Aerial transparencies were then made on color infrared transparency film (frame size 18" x 18") from an altitude of 65,000 feet through a 36" focal length lens. The resulting scale of the transparencies was 1:21,700.

The resolution achieved under the above conditions was insufficient for kit fox den identification. Only by first locating the white plastic markers could one see the reference dens.

Ground Field Work

The major portion of this study consisted of contacting people within the possible range of the San Joaquin kit fox who could supply reliable information about the animal; searching areas during the day for kit fox dens, scats, and tracks; and searching areas at night (with a spotlight) for kit fox.

A leaflet soliciting reports of kit fox sightings was prepared by the Contra Costa County Agricultural Commissioner's office and the California Department of Fish and Game (Exhibit IV, appended). Twelve hundred of the leaflets were distributed to people within possible kit fox range. In addition, people were personally interviewed to obtain information about kit fox sightings, and those so interviewed were asked to report future kit fox sightings.

Areas throughout the possible range were searched during the day for evidence of kit fox presence. After dark, approximately 150 hours were spent driving secondary roads and lightly used highways searching for kit fox by spotlighting.

Six kit fox spotlight routes similar to the seven routes currently checked by the California Department of Fish and Game were established. These six additional routes were checked in June and September of 1974 and in March and late May of 1975. Spotlighting was conducted with two people in one vehicle, each person shining a spotlight out from his side of the vehicle. In addition, high beam headlights were turned on. The spotlight routes were driven at 20 mph or less, and a record was kept of all mammals seen. This method is identical to that used by Department of Fish and Game personnel on their seven routes. Whenever eyeshine was seen, the vehicle was stopped and identification of the animal was attempted. Identification was achieved for 94.6 percent of the 112 sightings on the six spotlight routes. Locations of

all spotlight routes are shown on appended Figure IA, and the form used by Department of Fish and Game personnel to record spotlighting data is appended as Exhibit V.

Range Delineation

San Joaquin kit fox range maps prepared by Laughrin (1970) and Jensen (1973), and kit fox locations reported by Swick (1973a) and Waithman (1974b) were used as references. By plotting locations of sightings, road kills, and dens both from the previous maps and from data collected during this study, a map of the range of the San Joaquin kit fox in 14 counties was prepared. Over 600 kit fox locations were plotted on U. S. Geological Survey topographic maps of 1:250,000 scale. A delineation was made of the range boundary based on San Joaquin kit fox locations and occurrence of suitable habitat.

The number of square miles of valley floor and foothill habitat within the range of the San Joaquin kit fox was determined for each of the 14 counties supporting a kit fox population. Habitat area was measured on the range map with a planimeter. Figures VII and VIII illustrate uncultivated valley floor and foothill habitat.

The northernmost confirmed range of the San Joaquin kit fox is in Contra Costa County. Warden Graydon Harn, California Department of Fish and Game, reported a kit fox approximately five miles northeast of Napa in Napa County. The sighting was made the night of May 14, 1975. It was impossible for Warden Harn to determine the subspecies of the kit fox before the animal ran away.

RESULTS

Aerial Den Survey

Results of the 1974 ground survey and subsequent aerial sampling of the three check areas are presented in Table II. While one can determine kit fox dens

TABLE II. Den Counts from the Ground Survey and the Aerial Sampling of the Ground Survey Areas (Waithman-1974a)

LOCALITY (Size)	TYPE OF SURVEY	NUMBER OF DENS Active	Inactive	Total	AVERAGE NUMBER DENS PER SQUARE MILE
Carrizo Plain (2.25 square mi.)	Ground	9.0	16.0	25.0	11.1
	Air	3.8	25.0	28.8	12.8
	% diff.	58	36	13	
El Cano Field (2.00 square mi.)	Ground	3.0	21.0	24.0	12.0
	Air	11.4	13.0	24.4	12.2
	% diff.	74	38	2	
Buena Vista Valley (0.90 square mi.)	Ground	3.0	22.0	25.0	27.8
	Air	3.3	23.2	26.5	29.4
	% diff.	9	5	4	

FIGURE VII. Uncultivated Valley Floor Habitat, Buena Vista Valley, Kern County.

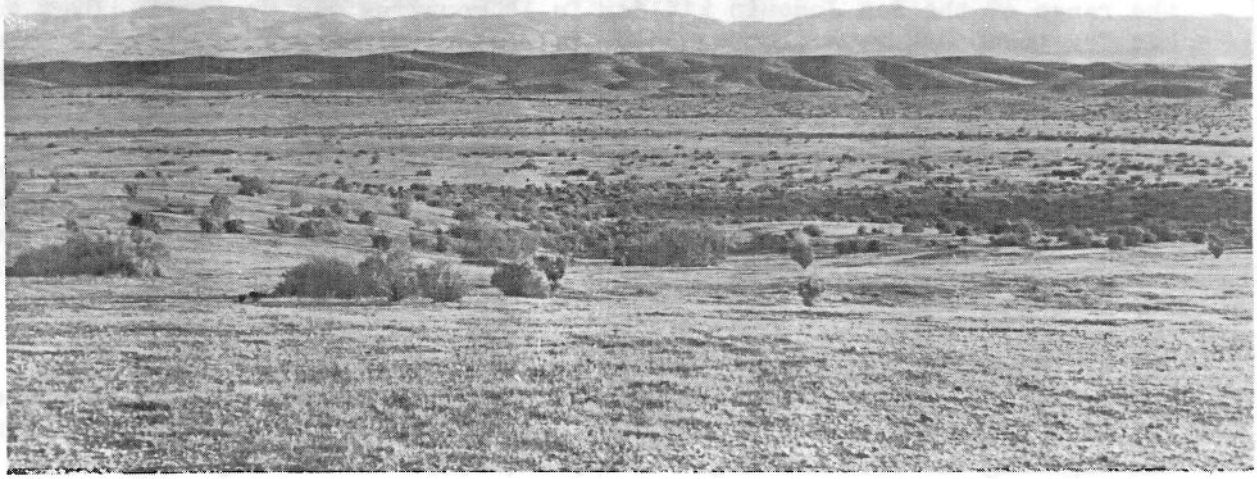


FIGURE VIII. Uncultivated Foothill Habitat West of Newman, Stanislaus County.

as such, it is not possible to accurately distinguish between active and inactive dens from the air. Therefore, only total den count figures were used for subsequent calculations.

The 1974 aerial survey covered a distance of 435.5 miles with a width of visibility (altitude 300 feet) of 0.25 mile (Waithman-personal communication). The total area surveyed was therefore 108.9 square miles. No kit fox dens were seen on 7 of the 25 transects, and the data from those 7 transects were deleted from subsequent calculations. Table III summarizes the 1974 aerial den survey.

The 1975 aerial survey covered a distance of 522.1 miles with a width of visibility (altitude 150 feet) of 0.13 mile. The total area surveyed in 1975 was therefore 67.9 square miles. No kit fox dens were seen on three of the transects, and the data from those three transects were deleted from subsequent calculations. Table IV summarizes the 1975 aerial den survey.

Data from both the 1974 and 1975 aerial surveys were placed in one of two categories, valley floor or foothill, depending upon whether the ground over which a transect was flown was, respectively, flat or hilly. The average number of total kit fox dens per square mile was calculated for each of the two categories. Those figures are presented in Table V.

TABLE V. Average Number of Kit Fox Dens per Square Mile

	1974	1975	MEAN
Valley floor	6.290 dens/square mi. (90% CL=5.272-7.308)	5.353 dens/square mi. (90% CL=3.188-7.518)	5.822 dens/square mile
Foothill	2.175 dens/square mi. (90% CL=1.665-2.685)	4.769 dens/square mi. (90% CL=2.982-6.556)	3.472 dens/square mile

CL=Confidence Limits

From the 1974 ground check, the ratio of 0.173 active to total dens (90% CL= 0.104-0.242) was calculated. This ratio was used to calculate active dens per square mile, since it was not always possible to distinguish between active and inactive dens from the air (Waithman-1974a). Results for both 1974 and 1975 are presented in Table VI. The ratio of active to total dens should be checked by ground surveys in selected areas throughout the range of the kit fox in future years to improve the accuracy of the population estimate.

TABLE III. 1974 Aerial Kit Fox Den Survey--Total Dens
(Waithman-personal communication)

Transect Number[1/]	County	Valley Floor			Foothill		
		Linear Miles	Dens	Dens/ Square Mile	Linear Miles	Dens	Dens/ Square Mile
1 (3-9)	Tulare-Kern	-	0	-	-	0	-
2 (3-1)	Kern	-	-	-	38.0	6	0.632
3 (3-2)	Kern	-	-	-	16.7	4	0.957
4 (3-3)	Kern	15.2	18	4.737	-	-	-
5 (3-4)	Kern	21.7	36	6.630	-	-	-
6 (3-5)	Kern	15.0	31	8.267	-	-	-
7 (3-6)	Kern-Kings	24.9	30	3.517	-	-	-
8 (3-7)	1974-Kings only 1975-Fresno-Kings	-	-	-	7.9	7	3.535
9 (3-8)	Kings-Kern	-	-	-	17.4	9	2.069
10 (1-1)	San Luis Obispo	24.8	51	8.226	-	-	-
11 (1-2)	1974-Santa Barbara only 1975-San Luis Obispo-Santa Barbara	-	0	-	-	0	-
12 (1-4)	San Luis Obispo	12.4	24	7.742	-	-	-
13 (1-3)	Santa Barbara	-	-	-	14.0	11	3.143
14 (2-6)	San Luis Obispo	10.6	16	6.038	-	-	-
15 (2-5)	San Luis Obispo	-	-	-	14.0	11	3.143
16 (2-7)	San Luis Obispo-Monterey	-	-	-	10.9	7	2.564
17 (2-8)	Monterey-San Luis Obispo	-	0	-	-	0	-
18 (2-4)	Monterey	6.2	8	5.161	-	-	-
19 (2-3)	Monterey	-	0	-	-	0	-
20 (2-2)	Monterey	-	-	-	6.3	2	1.266
21 (2-1)	Monterey	-	0	-	-	0	-
22 (4-1)	1974-Stanislaus-Merced only 1975-San Joaquin-Stanislaus-Merced	-	0	-	-	0	-
23 (4-2)	Merced	-	-	-	15.0	8	2.133
24 (4-3)	Merced-Fresno	-	-	-	60.8	35	2.303
25 (4-4)	Tulare	-	0	-	-	0	-

1/ Transects in parenthesis indicate 1974 transect numbers. First digit relates to day in April and second digit is number of transect for that day. Example (3-9) denotes the 9th transect flown on April 3, 1974.

TABLE IV. 1975 Aerial Kit Fox Den Survey--Total Dens

Transect Number[1/]	County	Valley Floor			Foothill		
		Linear Miles	Dens	Dens/ Square Mile	Linear Miles	Dens	Dens/ Square Mile
1 (3-9)	Tulare-Kern	-	-	-	35.6	33	7.0
2 (3-1)	Kern	20.5	10	3.7	12.6	6	3.5
3 (3-2)	Kern	22.2	12	4.0	-	-	-
4 (3-3)	Kern	14.7	17	8.5	-	-	-
5 (3-4)	Kern	21.3	38	13.6	-	-	-
6 (3-5)	Kern	14.4	28	14.7	-	-	-
7 (3-6)	Kern-Kings	32.8	40	9.1	-	-	-
8 (3-7)	1974-Kings only 1975-Fresno-Kings	-	-	-	12.8	21	12.4
9 (3-8)	Kings-Kern	14.3	17	8.9	8.5	9	7.5
10 (1-1)	San Luis Obispo	20.4	22	8.1	4.9	6	8.6
11 (1-2)	1974-Santa Barbara only 1975-San Luis Obispo-Santa Barbara	8.8	2	1.7	-	-	-
12 (1-4)	San Luis Obispo	-	-	-	16.9	13	5.9
13 (1-3)	Santa Barbara	6.6	0	0.0	9.7	6	4.6
14 (2-6)	San Luis Obispo	-	-	-	14.7	13	6.5
15 (2-5)	San Luis Obispo	-	-	-	21.9	2	0.7
16 (2-7)	San Luis Obispo-Monterey	-	0	-	-	0	-
17 (2-8)	Monterey-San Luis Obispo	9.1	1	0.8	-	-	-
18 (2-4)	Monterey	11.6	3	2.0	-	-	-
19 (2-3)	Monterey	-	0	-	-	0	-
20 (2-2)	Monterey	-	0	-	-	0	-
21 (2-1)	Monterey	-	-	-	30.3	2	0.5
22 (4-1)	1974-Stanislaus-Merced only 1975-San Joaquin-Stanislaus-Merced	-	-	-	44.4	11	1.9
23 (4-2)	Merced	5.2	1	1.4	8.9	1	0.8
24 (4-3)	Merced-Fresno	34.3	11	2.4	29.1	8	2.1
25 (4-4)	Tulare	10.3	2	1.4	-	-	-

1/ Transects in parenthesis indicate 1974 transect numbers. First digit relates to day in April and second digit is number of transect for that day. Example (3-9) denotes the 9th transect flown on April 3, 1974.

TABLE VI. Average Number of Active Kit Fox Dens per Square Mile

	1974	1975	MEAN
Valley floor	1.088 active dens/ square mile	0.926 active dens/ square mile	1.007 active dens/ square mile
	(81% CL=0.548-1.769)	(81% CL=0.332-1.819)	
Foothill	0.376 active dens/ square mile	0.825 active dens/ square mile	0.601 active dens/ square mile
	(81% CL=0.173-0.650)	(81% CL=0.310-1.587)	

The total area of valley floor and foothill habitat within the range of the San Joaquin kit fox was determined in each of the 14 counties which supports a kit fox population. The mean active den figures from Table VI were then multiplied by the number of square miles of respective habitat type, producing an estimate of the number of active kit fox dens in each county. Those figures were used to estimate the San Joaquin kit fox population by assuming two adult kit fox per active den in the spring. The population figures are presented in Table VII.

TABLE VII. San Joaquin Kit Fox Population Estimate

COUNTY	AREA (square miles) Valley floor	AREA (square miles) Foothill	NUMBER ACTIVE DENS Valley floor	NUMBER ACTIVE DENS Foothill	NUMBER ACTIVE DENS Total	ADULT KIT FOX POPULATION (2 adults per active den)
Alameda	90.4	135.8	91.0	81.6	172.6	345.2
Contra Costa	35.1	43.9	35.3	26.4	61.7	123.4
Fresno	349.6	338.5	352.0	203.4	555.4	1110.8
Kern	2172.5	934.3	2187.7	561.5	2749.2	5498.4
Kings	690.1	99.4	694.9	59.7	754.6	1509.2
Merced	73.4	180.0	73.9	108.2	182.1	364.2
Monterey	222.7	534.2	224.3	321.1	545.4	1090.8
San Benito	114.1	171.9	114.9	103.3	218.2	436.4
San Joaquin	39.3	64.1	39.6	38.5	78.1	156.2
San Luis Obispo	375.3	504.1	377.9	303.0	680.9	1361.8
Santa Barbara	33.5	65.0	33.7	39.1	72.8	145.6
Santa Clara	29.2	68.0	29.4	40.9	70.3	140.6
Stanislaus	35.6	60.2	35.8	36.2	72.0	144.0
Tulare	1180.9	22.7	1189.2	13.6	1202.8	2405.6
TOTALS	5441.7	3222.1	5479.6	1936.5	7416.1	14,832.2

Ground Field Work

Of the 1,200 leaflets that were distributed requesting reports of San Joaquin kit fox sightings, 80 were completed and returned. The 80 leaflets reported sightings and locations of 50 live kit fox, 26 dens, and 43 dead kit fox. Of the 43, 40 were road kills, 2 were shot, and 1 died from undetermined cause.

Results of the 6 kit fox spotlight routes surveyed in Fresno, Kern, Kings and San Luis Obispo counties are summarized in Table VIII. These surveys were inconclusive with respect to seasonal fluctuations and population trends because of the small number of times the surveys were conducted. However, spotlighting conducted by the Department of Fish and Game on established routes over a period of 5½ years did prove useful for indicating population trends and seasonal fluctuations. Results of the 7 kit fox spotlight routes surveyed every 3 months (except when roads were impassable) since March 1970 are summarized in Table IX.

TABLE VIII. 1974-75 Kit Fox Spotlight Routes

	Route Names					
Date	Buena Vista Valley	Woody	McKittrick-Lerdo Road	Devil's Den	Huron-Avenal	Carrizo Plain
	Average Number of Kit Fox Per Mile					
6/74	.08	.29	0	.42	0	.07
9/74	.66	.07	0	.18	.31	.47
3/75	.74	.04	.07	.24	.08	.13
5/75	.25	.04	0	.54	.23	.73

The spotlighting results in Table IX indicate an annual population peak in June, when the pups first join the adult population as hunters. The population is then reduced through the summer and fall until leveling in winter at what could be considered the approximate breeding population. These seasonal trends were to be expected based on the 1970-71 study of a kit fox population (Morrell-1971, 1972), and they indicate the validity of spotlight surveys.

The data indicate an overall increase in the kit fox population since 1970, with a slump indicated in 1972. I emphasize that these data do not serve for a numerical population estimate, but rather they indicate population trends at both seasonal and long-term levels.

TABLE IX. Department of Fish and Game Spotlight Routes 1970-75

Date	Route Names: Elkhorn Plain	Panoche	Blackwell's Corner	Belridge-McKittrick	Taft-Fellows	Northeast Bakersfield	Ortigilita Peak
	Average Number of Kit Fox Per Mile						
3/70	Not surveyed	.03*	.19	0	.14	.06	.27
3/71	.11	.09	.25	.06	.14	.03	.05
3/72	.22	.06	.13	.06	.10	.03	0
3/73	.11	Not surveyed	.10	.09	.10	.09	Not surveyed
3/74	.22	0	.27	.09	Not surveyed	0	0
3/75	.36	.06	.23	.03	.03	0	.16
6/70	.47	.12	.63	.21	.10	.03	.16
6/71	.50	.18*	.29	.09*	.07	.03	.11*
6/72	.36	0	.29	.03	.10	.06	.05
6/73	.19	.12	.27	.06	.10	.12	.27
6/74	.77	.09	.25	.06	.07	0	.38
6/75	.74	.03*	.96	.03	.07	0	.16*
9/70	.33	.03	.29	.12	.10	.09	.05
9/71	.39	.09	.29	.03*	.44	.12	.22
9/72	.14	.03	.48	.03	.03	.06	.05
9/73	.41	.09	.15	.06	.10	.12	.27
9/74	.52	Not surveyed	.23	.03	.07	.09	Not surveyed
12/70	Not surveyed	0*	.29	.06	.07	.09	.05*
12/71	.04	Not surveyed	.31	0	.20	.09	Not surveyed
12/72	.11	Not surveyed	.08	.06	.14	.03	Not surveyed
12/73	.19	Not surveyed	.42	.12	.10	.06	Not surveyed
12/74	.44	Not surveyed	.40	0	.10	.03	Not surveyed

* Spotlight route surveyed during either the month before or the month after the period indicated.

MORTALITY

The automobile is by far the major cause of reported San Joaquin kit fox deaths--128 of 152 deaths reported were caused by automobiles. Twelve kit fox were shot and 12 died from undetermined cause. A bias exists in these data, since animals killed by automobiles on roads are more likely to be seen and therefore reported than animals shot or otherwise killed away from roads. The fact remains, however, that the automobile is a major kit fox mortality factor. There is indication of a reduction in the number of kit fox illegally shot. Such a reduction is probably the result of the night hunting closure and increased public awareness of the protected status of the San Joaquin kit fox.

Based on my observations in the San Joaquin Valley, I feel that the loss of suitable habitat is the most significant mortality factor affecting the kit fox on the valley floor. Habitat loss is due mainly to conversion of uncultivated land to irrigated agriculture. A second major cause of habitat loss is construction projects. Unreported are kit fox losses attributed to habitat destruction. The accelerated conversion of uncultivated land to irrigated agriculture on the valley floor has undoubtedly caused a reduction in the kit fox population.

The effect on the kit fox of rodent control programs is uncertain.

DISCUSSION

The San Joaquin kit fox population estimate of 14,800 adults is almost certainly high, since large areas of irrigated agriculture were included in the calculations. While some agricultural areas do support kit fox, the population density appears to be significantly lower than in corresponding uncultivated habitat. Areas of intensive irrigated agriculture are apparently devoid of kit fox. The kit fox population density in those irrigated agricultural areas where they occur is not known at the present time. A second population estimate of 5,066 adult San Joaquin kit fox was made by subtracting the areas of urban development, irrigated agriculture, recreation sites, and standing water (as of 1972) within the range of the kit fox in Fresno, Kern, Kings, Merced, San Joaquin, Stanislaus, and Tulare counties from the total kit fox habitat area. For this purpose, the assumptions were made that a kit fox population does not exist in those 4 area types and that the areas were all on the valley floor. The areas were determined from U. S. Soil Conservation Service land use maps (prepared July 1972) of the San Joaquin Valley basin. The total number of adult kit fox was calculated based upon the reduced habitat area (Table X). Given the maximum kit fox population estimate of 14,800 and the minimum estimate of 5,066, a mean figure is 10,000.

Areas of critical habitat exist in Buena Vista Valley (Kern County), Elkhorn Plain (San Luis Obispo County), Cuyama Valley north of the Cuyama River (San

TABLE X. San Joaquin Kit Fox Minimum Population Estimate

County	Developed Acreage[1] (square miles)	Suitable Kit Fox Habitat (square miles)		Number of Active Dens			Adult Kit Fox Population[2]
		Valley Floor	Foothill	Valley Floor	Foothill	Total	
Fresno	215.1	134.5	338.5	135.4	203.4	338.8	677.6
Kern	1306.6	865.9	934.3	872.0	561.4	1433.5	2867.0
Kings	426.7	263.4	99.4	265.2	59.7	324.9	649.8
Merced	38.2	35.2	180.0	35.4	108.2	143.6	287.2
San Joaquin	45.4	0	58.0	0	34.9	34.9	69.8
Stanislaus	24.3	11.3	60.2	11.4	36.2	47.6	95.2
Tulare	986.1	194.8	22.7	196.2	13.6	209.8	419.6
						Total	5066.2

1/ Acreage in irrigated agriculture, urban and recreation developments and standing water. Figures not available for Alameda, Contra Costa, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Santa Clara Counties.

2/ Adult kit fox population calculated at 2 adults per active den.

Luis Obispo County), and other areas in the San Joaquin Valley wherever native vegetation exists supporting kit fox. These habitat areas are characterized by the plant and animal communities, or natural ecosystems, of which the San Joaquin kit fox is a part.

Loss of uncultivated habitat to irrigated agriculture and industrial and other developments is restricted almost completely to valley floor areas. Contained within the range of the kit fox are 3,222 square miles of foothill area supporting an estimated 3,800 adult San Joaquin kit fox (Tables VI and VII). The foothill areas are either owned by the government or are in large private land holdings. Such lands are devoted primarily to grazing sheep and cattle--practices which are not detrimental to the kit fox. Therefore, barring any unforeseen drastic change of land use practices in those foothill areas, the kit fox population can be considered not threatened.

The San Joaquin kit fox is able to exist with some types of irrigated agriculture. The agricultural crop must support a prey population and the kit fox must have an area in which to den. Examples of such coexistence are kit fox denning in canal levees, highway and railway berms, culverts under highways and along parts of the California Aqueduct, and along remnant drainages in agricultural areas. In addition, kit fox were found living in open areas

within such urban communities as Bakersfield and Taft. Where kit fox do exist in association with irrigated agriculture and urban development, their existence is considered marginal. A study is urgently needed to better understand kit fox ecology in areas other than its natural habitat.

FIGURE IX. Active San Joaquin Kit Fox Den on the California Aqueduct Right-of-Way Adjacent to a Vineyard, Kern County.

The effect on the kit fox of rodent control programs in which compound 1080 treated grain baits are used is uncertain and a matter of controversy. In a 1970 laboratory investigation conducted by the U. S. Fish and Wildlife Service, Schitoskey (1975) determined the LD_{50} (lethal dose for 50 percent of animals) for compound 1080 to be 0.22 mg/kg body weight for the desert kit fox. He felt the information could be extrapolated to cover the taxonomically similar San Joaquin kit fox. During the investigation, desert kit fox consumed kangaroo rats poisoned with three different toxicants including compound 1080. The reported LD_{100} (lethal dose for 100% of animals) for compound 1080 for Beechey ground squirrels is 0.35 mg/kg, and field evaluations have indicated that ground squirrels frequently consume several lethal doses of compound 1080 treated grain bait before death occurs (Swick-1973b). It is known that San Joaquin kit fox in the wild will eat carrion, including ground squirrels (Laughrin--1970; Morrell--1971, 1972).

A potentially lethal hazard can therefore be created for San Joaquin kit fox if surface rodent kills result from control programs using compound 1080 treated grain bait. However, San Joaquin kit fox are still present in apparently average density in areas where compound 1080 treated grain has been used for ground squirrel control for as long as 25 years. Swick (1973b) observed no impact on a small number of San Joaquin kit fox which were followed before and after a ground squirrel control program. That ground squirrel control program involved aerial application of compound 1080 treated grain bait, with bait actually applied on 89 of 700 acres (Swick-1973b). The available data indicate that present rodent control programs using compound 1080 treated grain baits may kill some kit fox, but such programs do not constitute a threat to the total San Joaquin kit fox population.

The data collected during the 1974 and 1975 aerial den surveys were the source of the San Joaquin kit fox population estimate. The aerial den survey is the easiest and fastest way to continue to monitor the status of the San Joaquin kit fox, and it is highly recommended that the survey be continued on an annual (or at least biennial) basis. The accuracy of population estimates made from the aerial den survey data will be increased if the ratio of active to total dens is checked by ground surveys in areas throughout the range of the kit fox. Determining the kit fox population density in different types of agriculture and determining the agriculture acreage will also increase the accuracy of the population estimate.

Five of the Department of Fish and Game spotlight routes--Panoche, Elkhorn Plain, Blackwell's Corner, Belridge-McKittrick, and Northeast Bakersfield--should be continued as presently conducted. The other 2 routes should be continued as presently conducted through December, 1975, and thereafter in June of each year. This will provide continuing data on the trends of kit fox populations in the various portions of kit fox range.

ACKNOWLEGMENT

To list all of the people who assisted with, and made possible, this study would require a prohibitive amount of space. I therefore thank as a group the employees of the following agencies who assisted me: California Department of Fish and Game, California Department of Food and Agriculture, U. S. Fish and Wildlife Service, county Agricultural Commissioners' Offices, U. S. Forest Service, U. S. Soil Conservation Service, California Department of Transportation, county road maintenance agencies, U. S. Bureau of Reclamation, California Department of Water Resources and local water districts, and National Aeronautics and Space Administration, Ames Research Center. I am also indebted to those individuals who helped me to search for kit fox, who reported kit fox sightings, and who allowed me access to their property. Special thanks is given to Howard R. Leach for program guidance.

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Exhibit I. Area Closed to Night Hunting (California Hunting Regulations--Part 1. 1975)

Nongame mammals may be taken only between one-half hour before sunrise and one-half hour after sunset in the following described area:

Beginning at a point where Little Panoche Road crosses Interstate Highway 5 near Mendota; southerly on Interstate 5 to State Highway 198; easterly on Highway 198 to State Highway 99; southerly on Highway 99 to its junction with Interstate Highway 5; southerly on Inkerstate 5 to the corner of Los Padres National Forest boundary in Section 8, T 9 N, R 19 W, S.B.B.M. near Fort Tejon Historical Monument; westerly along the National Forest boundary to Cerro Noroeste Road; northwesterly on Cerro Noroeste Road to its junction with State Highway 33-166; northerly on Highway 33-166 to its junction with the Soda Lake Road; northwesterly on the Soda Lake Road to the Kern-San Luis Obispo county line; northwesterly on the Simmler Soda Lake San Diego Creek Road to its junction with State Highway 58 at Simmler; westerly on Highway 58 to its junction with the Cammotti Shandon Road; northerly on the Cammotti Shandon Road to its junction with the Shandon San Juan Road; northerly on the Shandon San Juan Road to its junction with State Highway 41; northeasterly on Highway 41 to its junction with the Cholame Valley Road; northwesterly on Cholame Valley Road to the San Luis Obispo-Monterey County line; northwesterly on the Cholame Road to its junction with the Parkfield Coalinga Road in Parkfield; northerly on Parkfield Coalinga Road to the Monterey-Fresno county line; northerly on the Parkfield Grade to its junction with State Highway 198; westerly on Highway 198 to the Bear Canyon Coalinga Springs Road; northerly on the Bear Canyon Coalinga Springs Road to the Los Gatos Road; northwesterly on the Los Gatos Road to the Fresno-San Benito county line; northerly along the Fresno-San Benito county line to the Little Panoche Road; northerly and easterly on the Little Panoche Road to the point of beginning at Interstate Highway 5.

Exhibit II
1975

AERIAL KIT FOX DEN SURVEY

Date_____Transect #_____Observer_____ R or L side

Average speed and altitude_____

MINUTE	# ACTIVE DENS	# INACTIVE DENS	TOTAL # DENS
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			

Exhibit III
1975

FRONT SEAT--AERIAL KIT FOX DEN SURVEY

Date_____ Transect #_____ Observer_____

MINUTE	VEGETATION				COMPASS BRG.	ALTITUDE (feet)	SPEED (m.p.h.)
	0 sec.	15 sec.	39 sec.	45 sec.			
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

Exhibit IV

RARE AND ENDANGERED
SPECIES LEAFLET
SAN JOAQUIN KIT FOX

DISTRIBUTED BY
_____ COUNTY
DEPARTMENT OF AGRICULTURE
IN COOPERATION WITH THE
CALIFORNIA DEPARTMENT OF FISH AND GAME

The County Department of Agriculture recognizes the San Joaquin Kit Fox as one of the unique animals residing in the county and as such we have made special provisions for its protection. In conducting our ground squirrel program, we endeavor to use rodenticides in a manner which will not affect the Kit Fox. Your assistance in this protective effort is requested. Contact your local Agricultural Commissioner's office for information on the proper use of all rodenticides. Permits from the Agricultural Commissioner's office are required for certain rodenticides.

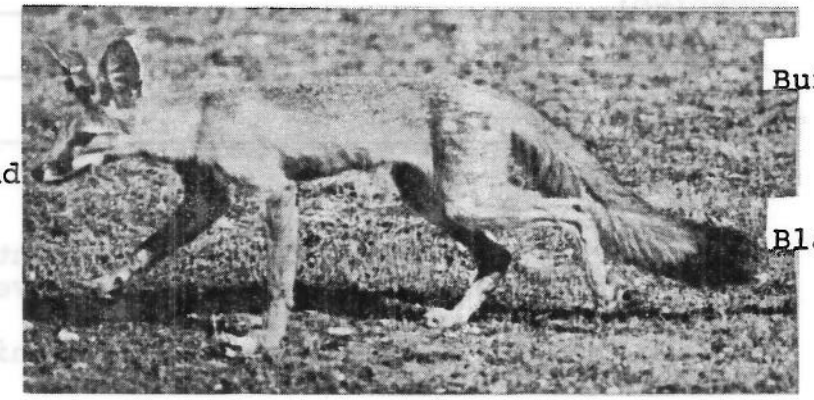
STATUS: The San Joaquin Kit Fox is classified as "endangered" by the United States Secretary of the Interior and "rare" by the California Fish and Game Commission. Taking and possession is prohibited by both state and federal law.

WHERE FOUND: Occurs from the Tehachapi Mountain foothills surrounding the southern end of the San Joaquin Valley north along the foothills of Western San Joaquin Valley to Byron, Contra Costa County, and on the eastern edge of the valley north to Visalia.

PREFERRED HABITAT: Floor of the valley with native vegetation or nearby rolling hills largely devoid of trees and brush. Occasionally found in agricultural areas.

DISTINGUISHING CHARACTERISTICS: The Kit Fox is distinguished by its small size and buffy tan coloration. Large ears, long legs, and a black-tipped tail are readily recognized. The California Gray Fox should not be confused with the Kit Fox because of its larger size and steel gray coloration. Gray Fox have short legs and a dark band of stiff hairs along the back and top of the tail which are conspicuous differences from the Kit Fox.

Large Ears



Buffy Tan

White Around Mouth

Black Tipped Tail

Long Legs

ACTIVITY: Kit Foxes usually spend most of the day in a burrow in soft, sandy soil. Burrows are about 9 inches in diameter and are round, in contrast to badger burrows which are more elliptical. Kit Fox have a fairly limited diet, with kangaroo rats, rabbits and insects making up the bulk of the food. Small rodents and birds are occasionally eaten. Kit Foxes are far more beneficial than harmful as they provide a natural check on rodent populations.

SIGHTINGS: If you see any Kit Fox, either alive or dead, please complete the observation report on this page and send it to the Department of Fish and Game.

KIT FOX OBSERVATION REPORT

DATE:_____ TIME OF DAY:_____

PLACE SEEN: Describe as precisely as possible, including miles to nearest landmark, elevation, county and other information.

DETAILS: Give number of animals and indicate whether adults or pups, if possible. If ear tag present, note color and which ear was tagged.

ACTIVITY OBSERVED: Hunting, crossing road, at den, dead along road, dead at location other than road.

NAME OF OBSERVER:_____

ADDRESS:_____

TELEPHONE:_____

California Department of Fish and Game
Special Wildlife Investigations
1416 Ninth Street
Sacramento, California 95814

Exhibit V

CALIFORNIA DEPARTMENT OF FISH AND GAME
SPECIAL WILDLIFE INVESTIGATIONS
1416 Ninth Street, Sacramento, CA 95814

KIT FOX SURVEY

ROUTE _____ NUMBER _____ DATE _____

	Start	Finish	Total
TIME			
MILEAGE			

SUNSET _____

MOONRISE _____

MOONSET _____

OBSERVER _____ MOON CONDITION _____
Last name First name

ADDRESS _____

Predator Observations

Species	Give time and mileage location of each predator	Total
Kit fox		
Gray fox		
Coyote		
Bobcat		
Badger		

Road kills: _____

Unidentified: _____

Prey Observations

Black-tailed jackrabbit		
Cottontail rabbit		
Kangaroo rat		
Pocket mouse		

NOTES: