BEFORE THE CALIFORNIA FISH AND GAME COMMISSION

A Petition to List the Desert Kit Fox
(Vulpes macrotis arsipus) as
Threatened under the California Endangered Species Act

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CENTER FOR BIOLOGICAL DIVERSITY, PETITIONER

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Executive Summary

The desert kit fox (*Vulpes macrotis arsipus*) is an uncommon to rare inhabitant of the Mojave and Colorado deserts in California. The subspecies has historically been broadly distributed across the California desert where it relies on sparsely vegetated scrub habitats such as creosote scrub communities that support abundant rodent populations. The desert kit fox has not been subject to assessment or monitoring efforts due to the assumption that its desert habitat would remain undeveloped and populations would remain stable. However, the desert kit fox is now being threatened by a suite of direct and indirect impacts due to the rapid increase in large-scale industrial renewable energy development in important habitat areas. The present and threatened modification or destruction of habitat from accelerating energy development in the California deserts poses the primary threat to the desert kit fox, which is being exacerbated by increasing habitat loss and degradation due to off-road vehicle use, grazing, agriculture, military uses, urbanization, and anthropogenic climate change.

At present, more than 114,000 acres of desert kit fox habitat are approved for large-scale industrial solar and wind development and close to 1 million acres of desert kit fox habitat are currently under environmental review or application for large-scale industrial solar and wind development as of January 2013. Key threats from large-scale industrial energy development to the desert kit fox include habitat loss, degradation, fragmentation, and loss of connectivity, as well as direct and indirect impacts resulting from reduced ability for movement, increased competition and predation, increased in non-native cover, mortality from roads, and displacement of foxes from den sites. In addition, a recent outbreak of canine distemper centered at a large-scale solar project site in the southern California desert highlights growing anthropogenic disease risks for the desert kit fox associated with habitat loss and development. Unfortunately, industrial-scale energy development projects approved to date have not properly considered the impacts and risks to the desert kit fox and the need to avoid, minimize and mitigate those impacts and risks to protect the species’ long-term survival.
I. Population Trends

Due to the lack of population monitoring, population trends for the desert kit fox in California are unknown. As detailed below, the loss, degradation, and fragmentation of desert kit fox habitat have been increasing, particularly in recent years, due to accelerating industrial energy development in important habitat areas, combined with off-road vehicle use, grazing, agriculture, military uses, urbanization, and anthropogenic climate change. The accelerating loss of habitat is likely to be contributing to population declines across the range, concentrated in regions with the greatest habitat impacts. The desert kit fox also experienced a local die-off in 2011 and 2012 due to a canine distemper outbreak in a region centered around the Genesis Solar energy development site in Riverside County.

II. Range and Distribution

The desert kit fox inhabits the Mojave and Colorado Deserts in California. The California Department of Fish and Game estimated the range of the desert kit fox as part of the California Wildlife Habitat Relationships (CHWR) system, and this range is summarized and presented in Figure 1.

A kit fox habitat suitability spatial data layer was created by SC Wildlands as part of the study *A Linkage Network for the California Deserts* (Penrod et al. 2012). A spatial data layer is used in a Geographic Information System (GIS) to create a map. This layer was created by weighting three different factors—vegetation, topography, and road density—to determine a continuous range of habitat suitability throughout the fox's range. This range had values from 0 to 9 and was binned into four different habitat categories—unsuitable, marginal, fair and good—to create the habitat suitability map in Figure 2.

The threshold values for the “good” category (8.8 - 9) were determined by areas with low road density, slopes less than 5%, and Creosotebush-White Bursage Desert Scrub or Mixed Salt Desert Scrub vegetation types. The threshold values for the “fair” category (7.3 - 8.8) were determined by areas of low slope less than 5% and either medium road density or other vegetation types suitable for kit foxes including playas and washes. The “marginal” habitat category (6.5 - 7.3) was determined by areas with slopes of 5% to 15% or vegetation types marginal for kit foxes like dune fields. Areas with habitat values less than 6.5 were considered unsuitable for kit foxes and included areas of high road density, slopes greater than 15%, or unsuitable vegetation types such as desert volcanic rocklands, desert bedrock cliff and outcrop, or cultivated cropland.
Figure 1. Range of the desert kit fox in California.
Source: California Wildlife Habitat Relationships Map for the desert kit fox\(^1\) based on GIS data.\(^2\)

\(^1\) [Link to Map](https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=2566&inline=1)

\(^2\) [Link to GIS Data](http://www.dfg.ca.gov/biogeodata/cwhr/cwhr_downloads.asp#CWHR_GIS_Data)
Figure 2: Habitat suitability map for the desert kit fox.
Source: Based on kit fox habitat suitability data layer created by SC Wildlands (Penrod et al. 2012); see text above for description of map values.
III. Abundance

The historic and current abundance of the desert kit fox in California have not been estimated due to the lack of monitoring. However, the desert kit fox is considered an “uncommon to rare permanent resident of arid regions of the southern portion of California” (CEC 2012a at pg. 4.2-62). Surveys on lands proposed for renewable energy development provide local estimates of numbers of active and inactive kit fox burrows, as summarized in Tables 1 and 4 below, which provide some measures of local abundance.

IV. Life History

A. Species Description

Grinnell et al. (1937) described the desert kit fox as a small fox of slender build, exceptionally large ears, and heavy underfur with slightly harsh texture. The fur color is a pale bleached gray with faint indications of rust, and a whitish underside. Hair inside the ears is white and the tail is black at the tip. The kit fox tail is about 40% of the total body length, and the soles of their feet are well-haired (McGrew 1979). This long hair between the pads of the feet is said to improve traction on sandy surfaces and protect their feet from hot soils in the summer. The grizzled appearance of kit fox fur results from guard hairs, which are prominent on the middle of the back (Ibid). The colors of kit fox muzzles show a large amount of variation, with adults from a single area having no black or brown on the muzzle, to shades of brown to black (Egoscue 1956). See Figure 3.

Sexual dimorphism is not marked, though females were found to be almost 15% lighter than males (McGrew 1979). Adult kit foxes weigh around 1.5 to 2.5 kilograms, stand 300 to 320 mm high at the shoulder, and their total length is 740 to 840 mm (Fitzgerald 1994 in Meaney et al. 2006). Kit foxes have a typically vulpine appearance, and can be differentiated from swift foxes by their larger ears (greater than 75 mm from the notch in kit foxes and less than 75 mm in swift foxes), more closely set ears, broader head, and longer tail (62% of body length in kit foxes and 52% in swift foxes) (McGrew 1979).

Figure 3: Desert kit fox.
B. Taxonomy

The kit fox (Vulpes macrotis) is a fox species present in North America. The taxonomy of kit foxes has been the subject of debate, with numerous revisions by various authors. Kit foxes are closely related to the swift fox, but are recognized as a separate species (Mercure et al. 1993). Seven (Hall 1981) or eight (McGrew 1979) subspecies of kit foxes have been historically recognized through morphometric studies. Of the two subspecies extant in California – the San Joaquin kit fox (Vulpes macrotis mutica) and the desert kit fox (Vulpes macrotis arsipus) – only the former is recognized as a sub-species by genetic studies (Mercure et al. 1993). However, the entire California desert population of kit foxes is classified as a single subspecies both morphologically and genetically, and has been historically referred to as the subspecies Vulpes macrotis arsipus in scientific literature addressing the population. For these reasons, the subspecies of desert kit fox (Vulpes macrotis arsipus) will be recognized for the purpose of this petition.

The historically recognized kit fox subspecies in the United States are V. m. arsipus (Southern California, southern Nevada, southwestern Utah, and Arizona), V. m. mutica (San Joaquin valley, California), V. m. neomexicana (New Mexico), and V. m. nevadensis (Nevada, western Utah, southern Oregon) (McGrew 1979).

C. Reproduction and Growth

Kit foxes are usually monogamous, with polygamy occurring infrequently. Pairs remain together throughout the year, and relationships may last indefinitely or until the death of one of members (Egoscue 1956). Vixens as young as 10 months of age begin searching for natal dens in September and October (McGrew 1979, O’Farrell and Gilbertson 1986), often visiting and cleaning every usable den within their home range before they finally select a natal den (McGrew 1979). Males join the females at the natal den in October or November, and the breeding season lasts from December to February. Kit foxes are monoestrous, and copulation occurs as it does with most canids. However, their courtship behavior has not been described (Egoscue 1956, McGrew 1979). The length of gestation is presumed to be 49 to 56 days, similar to red foxes, with litters being born in February or March (McGrew 1979). Litter sizes reported by various authors range from 1 to 6 (Cypher 2003) to 4 or 5 (McGrew 1979), with reported average litter sizes of 4.6 (O’Neal 1997 in Meaney et al. 2006) and 3.8 (Cypher et al. 2000). Vixens rarely leave young suckling pups, and males do most of the hunting during this period. Pups begin to forage with parents at three to four months of age (McGrew 1979). Family groups generally split up in October, although some members may disperse and others may remain together (Meaney et al. 2006). Kit fox pups attain 90% of their adult body mass by 10 months of age (Warrick and Cypher 1999 in Meaney et al. 2006).

The reproductive success of kit foxes has a large amount of variation, with one sub-population reporting 20% success in one year and 100% in the next. Adult females are generally more successful at reproducing than yearling females. Adult females also have larger litters than yearlings (Cypher et al. 2000). Reproductive success and the litter size of females, particularly yearlings, decrease during periods of low prey abundance. As a result, reproductive rates are strongly repressed by periods of prey scarcity (White and Garrott 1999). Adults may lose weight from June through August, when demands from the litter are heaviest (McGrew 1979).
D. Movement

Kit foxes are almost entirely nocturnal, and daytime activity is confined to the vicinity of the den (Egoscue 1956). The first account of the movement of desert kit foxes recorded the maximum foraging distance from the den as two miles (Grinnell 1937). Nightly movements vary with seasonality and rodent abundance (Egoscue 1956). In Western Arizona, male and female desert kit foxes traveled a mean of 14.3 and 11.8 km per night respectively. Males traveled greater distances during the breeding season than during pup rearing and pair formation -- a trend which was also noted in a study on San Joaquin kit foxes (Zoellick et al. 2002). The greatest reported distances traveled by kit foxes are as far as 32 km traveled by a pet kit fox, and 42 km by a kit fox tagged as a pup (McGrew 1979).

Kit foxes with pups occasionally abandon dens suddenly, and the probable causes are depletion of food supply or a build up of ectoparasites in the den (Egoscue 1956) and external disturbance or interference. A study by Egoscue (1956) suggests that males do most of the hunting during the early pup rearing period. Pups emerge from dens at four to five weeks old and begin to forage with parents at three to four months old (Meaney et al. 2006). Although nightly foraging distance is greater in males than females, home range sizes between sexes do not differ, with estimates of home range varying from 251 ha to 1,160 ha (Cypher 2003 in Meaney et al. 2006). Difference in the size of home ranges may be related to food availability (Spiegel 1996).

Juvenile kit foxes monitored in a study by Koopman et al. (2000) on the Naval Petroleum Reserves in California had a 33% dispersal rate from their natal territory. Males had a higher dispersal rate (49.4%) than females (23.8%), with dispersal peaking in July. The average annual dispersal of all monitored juveniles ranged from 0 to 52%. The study concluded that dispersal patterns of kit foxes may be a function of innate sex-biased dispersal altered by physical and biological pressures. Annual dispersal rates varied from 0 to 79% for males, and 0 to 50% for females, and 0 to 52% for all juveniles. Male dispersal was weakly correlated to mean annual litter size, whereas female dispersal rates were weakly and inversely correlated to small-mammal abundance. Dispersal began in June and peaked in July, but individuals dispersed in almost all months. The mean age at dispersal was 8 months, and 87% of juveniles dispersed in their first year. Survival increased with age of dispersal, but 65% of individuals died within 10 days of dispersing.

E. Diet and Foraging Ecology

Kit foxes are “opportunistic primary, secondary and tertiary consumers and scavengers, likely regulated by prey abundance” (Cypher 2003 in Meaney et al. 2006). The primary prey of kit foxes are kangaroo rats (Dipodomys sp.) that are locally abundant. Several authors have emphasized the correlation between the ecological and geographical distribution of kit foxes and Dipodomys (Meaney et al. 2006). Merriam’s Kangaroo rat (Dipodomys merrami) is the primary prey of the desert kit fox in the Californian Desert (NPS 2012). Kit foxes are opportunistic feeders to some extent; however, Egoscue (1975) found no evidence of switching to diurnal prey or moving to areas of greater abundance of secondary prey when experiencing a decline in primary prey species. Similarly, White et al. (1996) found that San Joaquin kit foxes did not shift their diets to other mammalian prey species when their prey was scarce, which led to declines in kit fox abundance due to fewer females successfully rearing young and higher coyote-related mortality. The study suggested that the “population dynamics of kit foxes may be similar to those of obligate predators due to their apparent
unwillingness or inability to switch to abundant, alternate prey during declines in density of their preferred prey” (White et al. 1996: 370).

Other common prey species include leporids (rabbits and hares), rodents, and insects. Kit foxes also consume birds, reptiles, carrion, and rarely, plant material such as cactus fruits (List and Cypher 2004). Kit foxes are known to cache food and consume anthropogenic food (Cypher 2003). Desert kit foxes generally meet their water requirements through consumption of food. Kit foxes in captivity consume water that is offered to them, but in the wild they consume 150% of their daily energy requirements in order to meet their water requirements (Golightly and Ohmart 1984).

Kit fox abundance is strongly tied to precipitation which affects prey abundance. A study by Cypher et al. (2000) showed that San Joaquin kit fox density was positively related to both current and previous year’s composite prey indices, which were strongly related to the previous year’s effective precipitation. For a three year period, yearly precipitation explained 79% (p <0.001) of the annual variation in kit fox abundance. Similarly, Dennis and Otten (2000) found that growing season rainfall affects the abundance of San Joaquin kit foxes two years later, through effects on their kangaroo rat and leporid prey.

There is substantial overlap in the diets of coyotes and San Joaquin kit foxes, indicating a high potential for resource competition which may be amplified by low mammalian prey availability during droughts (White et al. 1995). The interaction between coyotes and desert kit foxes over common prey in the Californian desert has not been studied. Low food availability may result in reduced adult survival of kit foxes if individuals are forced to forage for longer periods and greater distances, which increases the risk of mortality from predation and other sources (Cypher 2003 in Meaney et al. 2006).

F. Ecological Niche

As mentioned previously, kit fox distribution is strongly linked with creosote scrub bush and the small mammal abundance associated with that community (Meaney et al. 2006). Kit foxes are “opportunistic primary, secondary and tertiary consumers and scavengers, likely regulated by prey abundance” (Cypher 2003 in Meaney et al. 2006).

G. Mortality and Population Regulation

Larger predators such as wolves and coyotes almost always co-occur with foxes, and kit foxes are usually subject to intense interference competition and exploitative competition from coyotes in particular (Cypher 2003). Death due to starvation has been recorded in desert kit foxes in the Mojave desert region (O’Farrell and Gilbertson 1986). Coyotes were found to cause significant mortality in kit fox populations in California (White et al. 1995).

Kit foxes are susceptible to infection by numerous diseases and parasites; however, only a few diseases, such as rabies and canine distemper, can produce population level impacts (Cypher 2003 in Meaney et al. 2006). Although disease is typically not a major source of mortality in kit foxes in California, there have been several instances of viral diseases causing catastrophic declines in Island foxes and San Joaquin kit foxes. In San Joaquin kit foxes alone, antibodies against canine parvovirus, infectious canine hepatitis, canine distemper, brucella canis, toxoplasma gondii, and vesicular stomatitis, among others,
have been detected (McCue and O’Farrell 1988). These threats of morbidity and mortality caused by disease are discussed in detail below.

A study on the effect of roads on San Joaquin kit foxes found vehicles to be the primary cause of mortality among urban kit foxes (Bjurlin et al. 2005). Kit foxes did not appear to avoid roads when selecting den sites, and males were particularly vulnerable to vehicle strikes during the mating season. Urbanization and industrial development of the California desert region presents a growing risk to desert kit fox populations. Vehicle strikes were found to be a significant cause of mortality in kit foxes in a desert valley in Utah as far back as 1962 (Egoscue 1962).

Kit foxes can live for around seven years in the wild, with estimates for the mean survival probability of kit foxes ranging from 0.36 to 0.71 annually (Spiegel and Disney 1996 in Cypher et al. 2000), and the probability of the survival of juveniles ranging from 0.21 to 0.41 (Ralls and White 1995).

Prey abundance, precipitation, interference competition and predation from coyotes, and behavioral spacing mechanisms are thought to be important factors regulating fox populations (White and Garrott 1997, 1999).

V. Kind of Habitat Necessary for Survival

The desert kit fox primarily inhabits sparsely vegetated scrub habitats and native or annual grasslands with abundant rodent populations, such as alkali sink scrub, saltbush scrub, and chenopod scrub, although oak woodlands, vernal pools, alkali meadows and playas also provide habitat (USFWS 1998, Brown et al. undated mat. in Penrod et al. 2012). In the California desert region, desert kit fox populations are closely associated with creosote scrub bush communities (McGrew 1979).

Kit foxes are semifossorial and primarily nocturnal, residing in subterranean dens with typical keyhole shaped entrances. The kit fox requires friable soils for excavating dens which they use throughout the year for cover, thermoregulation, water conservation, and raising young (CEC 2012a). The elevation of kit fox den locations in the Mojave Desert according to a study by O’Farrell and Gilbertson (1986) ranged from 585 to 830 m. Almost all the dens in this study were located on gradual west to northwest facing slopes, with characteristically deep, light-textured and virtually stoneless soils, with no observable caliche or hardpan layer, and in well-drained sites (O’Farrell and Gilbertson 1986). In New Mexico, kit fox dens were also located in creosote bush-dominated habitat, and were found in well drained terrain with a slope less than 5%. Kit foxes prefer the presence of short, patchy vegetation in their denning habitat (Egoscue 1962, O’Farrell and Gilbertson 1986). Rocky soils with steeper slopes, ranging from 5% to 20%, were found to be unsuitable for den excavation. Kit foxes are also able to adapt to open habitats including creosote flats and grasslands (Rodrick and Mathews 1999). Egoscue (1962) suggested kit foxes utilize sandy dune habitat for foraging.

VI. Factors Affecting Ability to Survive and Reproduce

Human land use changes and anthropogenically-induced disease risks threaten the ability of the desert kit fox to survive and reproduce. The most significant threats to the desert kit fox are the rapid expansion of large-scale industrial renewable energy developments in kit
fox habitat and an outbreak of canine distemper associated with at least one of these energy developments. The rapid expansion of large-scale industrial energy development threatens the desert kit fox by excluding desert kit foxes from historic habitat areas; destroying, degrading, and fragmenting habitat; inhibiting kit fox movements; increasing stress and sub-lethal impacts; increased risk of disease introduction including deadly canine distemper; and by direct mortality. Other significant threats, which cumulatively threaten the desert kit fox, include habitat loss and degradation from off-road vehicles, livestock grazing, agriculture, urbanization, military activities, and anthropogenic climate change. Each of these threats is discussed in detail below.

A. Present or Threatened Modification and Destruction of Habitat

Modification, destruction, and fragmentation of the natural habitat of the desert kit fox by accelerating large-scale industrial energy development in important habitat areas poses a key threat to the desert kit fox, and is being exacerbated by negative impacts from anthropogenic disease risks associated with development, roads and off-road vehicles, urbanization, livestock grazing, military use of desert kit fox habitat, anthropogenic climate change and proposed railway development. These threats affect a large proportion of desert kit fox habitat in the Mojave and Colorado Deserts, as illustrated by Figure 4.

Figure 4: Threats to desert kit fox habitat in California.
Sources: See text above for GIS data sources.
1. Renewable energy development

Habitat loss and fragmentation from the rapid expansion of large-scale industrial solar and wind energy development in the Mojave and Colorado Deserts pose a current and growing threat to the desert kit fox. Since 2007, almost 39,000 acres of solar energy projects in the Mojave Desert have been approved, most of which are under construction (Table 1), and an additional 30,622 acres of solar energy projects are in review (Table 1). In addition, the public lands within the range of the desert kit fox in California currently have eighteen pending applications for solar energy projects and transmission lines, totaling over 96,000 additional acres spread throughout the desert kit fox’s range (Table 2). In sum, the current and potential development for solar energy projects in desert kit fox habitat totals approximately 165,000 acres at present. Adding to the threats from solar energy development, the current potential cumulative development for wind in desert kit fox habitat could cover close to 850,000 acres. As of January 2013, eleven wind projects covering almost 75,000 acres have been approved with many of them in the construction phase (Table 4). Three additional projects covering 16,611 acres are currently under environmental review (Table 5). In addition, twenty-seven projects are authorized to do wind testing on almost 270,000 acres, and another forty wind project applications are in development or propose testing, covering an additional 485,000 acres (Table 6).

As detailed below, nearly 9% of desert kit fox habitat identified as good, fair, or marginal in quality (see Figure 2) falls within areas designated for approved or potential solar and wind developments on public lands. This percentage does not include the extensive solar and wind developments on private lands in desert kit fox habitat, already approved projects on public lands or the impacts from the other threats to habitat illustrated in Figure 4. In addition, solar and wind development areas on public land overlap 13 of the 16 movement corridors that are considered highly important for kit fox habitat connectivity by Penrod et al. (2012) (see Figure 6). Of concern for the desert kit fox, these large-scale industrial energy developments, including associated transmission lines and roads, have a range of direct and indirect impacts on the desert kit fox, and do not properly consider or mitigate for impacts on the desert kit fox.

a. Large-scale solar energy developments

i. Increases in large-scale solar energy development in desert kit fox habitat

Large-scale solar energy development is a relatively new phenomenon in the Mojave and Colorado Deserts, with the first commercial solar plant being built in San Bernardino County in 1984. Between 1984 and 1991, a total of 10 Solar Energy Generating System (SEGS) power plants were commissioned and built, occupying a total of approximately five square miles of desert land in three locations. Since then, renewed interest in large-scale industrial solar energy development began with the Energy Policy Act of 2005, which increased tax incentives for developers from 10 to 30 percent, and also stated that within ten years of the date of enactment, the Secretary of the Interior should “seek to have approved non-hydropower renewable energy projects located on the public lands with a generation capacity of at least 10,000 megawatts of electricity.” Additionally, in February 2009,

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8.5% includes the 4.0% of good/fair/marginal habitat that falls on solar variance land, the 0.8% on solar development lands, and 3.8% on wind application lands.
Congress passed the American Recovery and Reinvestment Act of 2009 (ARRA) that allocated over $16.8 billion in funds for the DOE’s Office and Energy Efficiency and Renewable Energy (EERE). Money was also allocated for a renewable energy grant program that provided 30 percent grants in lieu of investment tax credits for projects that broke ground before 2011. ARRA expanded the Innovative Technology loan guarantee program with $6 billion for projects that commenced construction by September 30, 2011. The BLM then announced a “fast-track” program in 2009 to speed up the review process for large-scale renewable energy development on public lands.

Since 2007, almost 39,000 acres of solar energy projects in the Mojave Desert have been approved (15 projects comprising 33,373 acres of public land and 5,463 acres of private land), and most of these projects are under construction (Table 1). An additional ~31,000 acres of solar energy projects are in review (8 projects comprising 19,885 acres of public land and ~11,000 acres of private land), totaling almost 70,000 acres of current and potential development in desert kit fox habitat (Table 1). In addition, the public lands within the range of the desert kit fox in California currently have 18 pending applications for solar energy projects and transmission lines, totaling over 96,000 additional acres spread throughout the desert kit fox’s range (Table 2) (BLM 2012a). As highlighted in Table 1, desert kit foxes have been documented to occur on all currently approved solar energy development sites. At some sites, extensive burrow complexes were documented.

Table 1: Approved and in-review solar energy developments on public and private lands in California, and occurrence and management of desert kit foxes per project.

<table>
<thead>
<tr>
<th>Name</th>
<th>County</th>
<th>Status</th>
<th>Size (acres)</th>
<th>Occurrence and management of desert kit foxes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice Solar Energy Project</td>
<td>Riverside</td>
<td>Approved</td>
<td>1,537</td>
<td>Detected kit foxes during desert tortoise surveys; determined to occur throughout the Project area and along transmission line; management plans include pre-construction surveys and avoidance measures (Rice Solar Energy Project 2010).</td>
</tr>
<tr>
<td>Palen Solar Power Project</td>
<td>Riverside</td>
<td>Approved at State level but should require additional review because of technology change. Pending at Federal level.</td>
<td>5,200</td>
<td>71 kit fox burrows and complexes observed in the study area; estimated permanent loss of 3,899 acres of habitat; management plans include pre-construction surveys and mitigation measures (Palen Solar Project 2010).</td>
</tr>
</tbody>
</table>

Sources: BLM5 and CEC6 websites.

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6 [http://www.energy.ca.gov/siting/solar/](http://www.energy.ca.gov/siting/solar/)
<table>
<thead>
<tr>
<th>Project Name</th>
<th>Location</th>
<th>Technology Status</th>
<th>Approved</th>
<th>Acres</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calico Solar Project</td>
<td>San Bernardino (public)</td>
<td>Approved</td>
<td>4,604</td>
<td></td>
<td>39 potential kit fox dens were detected during burrowing owl surveys; estimated permanent loss of 8,320 acres of potential kit fox habitat; management plans include pre-construction and mitigation measures (Calico Solar 2010).</td>
</tr>
<tr>
<td>Genesis Solar</td>
<td>Riverside (public)</td>
<td>Approved</td>
<td>1,950</td>
<td></td>
<td>Desert kit fox burrows, complexes and scat observed throughout the study area in 2009 field surveys; over 65 kit fox burrow complexes, both active burrows with fresh scat present and inactive burrow complexes, were observed throughout area; management plans include preconstruction surveys and mitigation (Genesis Solar Energy Project 2010). First recorded canine distemper outbreak in desert kit fox originated at this project site.</td>
</tr>
<tr>
<td>Imperial Solar (West)</td>
<td>Imperial (private)</td>
<td>Approved</td>
<td>65</td>
<td></td>
<td>Observations of desert kit foxes, dens, and tracks made on site (Imperial Solar Energy Center West 2010).</td>
</tr>
<tr>
<td>Imperial Solar (South)</td>
<td>Imperial (private)</td>
<td>Approved</td>
<td>83.7</td>
<td></td>
<td>Observations of desert kit fox habitat were made during burrowing owl surveys (Imperial Solar Energy Center South 2010).</td>
</tr>
<tr>
<td>Imperial Valley Solar</td>
<td>Imperial (public)</td>
<td>Authorization terminated at developer request</td>
<td>6,500</td>
<td></td>
<td>Desert kit fox sign were detected on site, which includes marginally suitable foraging and denning habitat (SES Solar Two Project 2010).</td>
</tr>
<tr>
<td>Ivanpah Solar</td>
<td>San Bernardino (public)</td>
<td>Approved</td>
<td>3,471</td>
<td></td>
<td>Desert kit foxes were photographically documented at the site (Ivanpah SEGS 2007).</td>
</tr>
<tr>
<td>Solar Millenium Blythe</td>
<td>Riverside (public)</td>
<td>Approved</td>
<td>7,025</td>
<td></td>
<td>Desert kit fox burrows, complexes, and scat observed throughout study area; several kit fox burrows and complexes found within the substation and transmission line survey areas; estimated permanent loss of 7,077 acres of occupied habitat; management plan includes pre-construction surveys and mitigation (Blythe Solar Power Project 2010).</td>
</tr>
<tr>
<td>Abengoa Mojave Solar Project</td>
<td>San Bernardino (private)</td>
<td>Approved</td>
<td>1,765</td>
<td></td>
<td>Two kit fox natal den sites were detected during 2009 surveys; three active kit fox den complexes were detected during 2011 surveys; management plans include pre-construction surveys and mitigation (Abengoa Mojave Solar Project 2011).</td>
</tr>
<tr>
<td>Beacon Solar Energy Project</td>
<td>Kern (private)</td>
<td>Approved</td>
<td>2,012</td>
<td></td>
<td>Desert kit fox sign was detected within the survey area although not on the project site, very few suitable burrows observed on the project site, some high quality habitat on site; management plans include pre-construction surveys and mitigation (Beacon Photovoltaic Project 2012).</td>
</tr>
<tr>
<td>Project Name</td>
<td>Location</td>
<td>Status</td>
<td>Acres</td>
<td>Notes</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------</td>
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<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(public, transmission)</td>
<td></td>
<td>(transmission line only)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Campo Verde Solar Project</td>
<td>Imperial</td>
<td>Approved</td>
<td>17</td>
<td>Potential desert kit fox burrows observed throughout the project area within the desert scrub and agricultural drain areas (Campo Verde Gen-Tie Project 2012).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(public, transmission)</td>
<td></td>
<td>(transmission line only)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chevron Lucerne</td>
<td>San Bernardino</td>
<td>Approved</td>
<td>422</td>
<td>Kit foxes observed or detected during surveys (Chevron Lucerne Valley Project 2009).</td>
<td></td>
</tr>
<tr>
<td>Desert Sunlight Solar Farm Project</td>
<td>Riverside</td>
<td>Approved</td>
<td>4,165</td>
<td>Kit fox dens have been detected on site (Desert Sunlight Solar 2011a); management plans include pre-construction surveys and passive relocation (Desert Sunlight Solar 2011b).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(public)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total: 15 projects</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>Total: 38,836 acres</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Status: Under Review</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rio Mesa SEGF</td>
<td>Riverside</td>
<td>Under Review</td>
<td>3,960</td>
<td>193 kit fox burrows and complexes found in project area in 2011: 67 in current proposed fenced development area (Fig 5); management plans include pre-construction surveys and passive relocation (Rio Mesa Solar 2012).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(private)</td>
<td>(suspended)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hidden Hills SEGF</td>
<td>Inyo</td>
<td>Under Review</td>
<td>3,277</td>
<td>46 kit fox burrow complexes identified on site (19 considered active and 27 inactive), 2 young kit foxes observed, 8 additional single kit fox burrows identified (2 active) (CEC 2012a).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(private)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fremont Valley Preservati on Project</td>
<td>Kern</td>
<td>Under Review</td>
<td>3,500-4000</td>
<td>Unknown at this time; only Notice of Prep available(<a href="http://pcd.kerndsa.com/planning/not">http://pcd.kerndsa.com/planning/not</a> ices-of-preparation).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(private)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NextEra McCoy</td>
<td>Riverside</td>
<td>Under Review</td>
<td>8,177</td>
<td>57 desert kit fox natal dens observed: 34 within solar plant site and 8 along gen-tie line and access route road (McCoy Solar 2012).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(public)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desert Harvest</td>
<td>Riverside</td>
<td>Under Review</td>
<td>1,248</td>
<td>Numerous desert kit fox burrows recorded on site (Desert Harvest Solar 2012).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(public)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stateline</td>
<td>San Bernardino</td>
<td>Under Review</td>
<td>2,143</td>
<td>Kit fox burrows, tracks, and scat detected on site (Stateline Solar Farm Project 2012).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(public)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soda Mountains</td>
<td>San Bernardino</td>
<td>Under Review</td>
<td>4,397</td>
<td>Unknown at this time; only Notice of Intent available(<a href="http://www.blm.gov/ca/st/en/fo/bar">http://www.blm.gov/ca/st/en/fo/bar</a> stow/renewableenergy/soda_mountain.html)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(public)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ridgecrest</td>
<td>Kern</td>
<td>Under Review</td>
<td>3,920</td>
<td>Desert kit fox dens, sign, and animals were detected throughout the project site and survey buffer areas (Ridgecrest Solar 2010).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(public)</td>
<td>(suspended)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total : 8 Projects Under Review</strong></td>
<td></td>
<td></td>
<td>30,622 – 31,122 acres</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total: 23 Approved Projects and Projects Under Review</strong></td>
<td></td>
<td></td>
<td>69,458 – 69,958 acres</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 5: Hidden Hills Solar Electric Generating System, showing kit fox burrows observed during biological surveys of the proposed facility.
Source: Hidden Hills Figures 4 and 5 – 2011-12-05- Applicants Data Response Data_Response_Set1B_TN-63056.7

Table 2: Pending applications for large-scale solar energy developments on public lands in California.
Source: BLM websites

<table>
<thead>
<tr>
<th>Project Name</th>
<th>County</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadwell SEGS</td>
<td>San Bernardino County</td>
<td>8,625 acres</td>
</tr>
<tr>
<td>Siberia SEGS</td>
<td>San Bernardino County</td>
<td>13,920 acres</td>
</tr>
<tr>
<td>Troy Lake Soleil</td>
<td>San Bernardino County</td>
<td>3,834 acres</td>
</tr>
<tr>
<td>Johnson Valley SEGS</td>
<td>San Bernardino County</td>
<td>1,560 acres</td>
</tr>
<tr>
<td>Imperial Solar</td>
<td>Imperial County</td>
<td>4,000 acres</td>
</tr>
<tr>
<td>Ocotillo Sol</td>
<td>Imperial County</td>
<td>115 acres</td>
</tr>
<tr>
<td>Dixieland Solar Farm</td>
<td>Imperial County</td>
<td>246 acres</td>
</tr>
<tr>
<td>Desert Quartzite</td>
<td>Riverside County</td>
<td>7,245 acres</td>
</tr>
<tr>
<td>McCoy (EDF-RE)</td>
<td>Riverside County</td>
<td>20,480 acres</td>
</tr>
<tr>
<td>Mule Mountain III</td>
<td>Riverside County</td>
<td>8,160 acres</td>
</tr>
<tr>
<td>Gypsum Solar</td>
<td>Riverside County</td>
<td>2,840 acres</td>
</tr>
<tr>
<td>Chuckwalla</td>
<td>Riverside County</td>
<td>4,482 acres</td>
</tr>
<tr>
<td>Sonoran West SEGS</td>
<td>Riverside County</td>
<td>12,269 acres</td>
</tr>
<tr>
<td>Victory Pass</td>
<td>Riverside County</td>
<td>260 acres</td>
</tr>
<tr>
<td><strong>Total: 15 projects</strong></td>
<td></td>
<td><strong>95,685 acres</strong></td>
</tr>
</tbody>
</table>

**Transmission Only**

<table>
<thead>
<tr>
<th>Project Name</th>
<th>County</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silverleaf Solar</td>
<td>Imperial Valley</td>
<td>14 acres</td>
</tr>
<tr>
<td>Rio Mesa</td>
<td>Riverside County</td>
<td>500 acres</td>
</tr>
<tr>
<td>Blythe Mesa</td>
<td>Riverside County</td>
<td>485 acres</td>
</tr>
<tr>
<td><strong>Total: 3 transmission projects</strong></td>
<td></td>
<td><strong>999 acres</strong></td>
</tr>
<tr>
<td><strong>Total: 18 all projects</strong></td>
<td></td>
<td><strong>96,684 acres</strong></td>
</tr>
</tbody>
</table>

In 2012, BLM adopted the Record of Decision for Solar Energy Development in Six Southwestern States ("Solar Program ROD") (BLM and DOE 2012b). The Solar Program ROD identified two Solar Energy Zones (SEZs) in California where the BLM will prioritize and facilitate utility-scale production of solar energy and associated transmission infrastructure development: the Riverside East SEZ located in Riverside County, and the Imperial SEZ located in Imperial County. Both Solar Energy Zones occur in areas that fall

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under the Northern and Eastern Colorado Desert Coordinated Management Plan (NECO). The Solar Program ROD also identifies additional “Variance Areas” on public lands across the Mojave and Colorado Deserts where developers can request the BLM to consider the development of a solar project outside of a Solar Energy Zone.

We conducted an analysis to determine the amount of desert kit fox habitat that falls within the Solar Program ROD development and variance zones on public lands (see Figure 6). The results of this analysis (see Table 3) shows that 5% of desert kit fox habitat ranked as “good,” “fair,” or “marginal” (see Figure 2) falls within solar development and variance zones in which habitat can be destroyed and degraded by industrial-scale renewable energy developments. Overall, ~5.3% of desert kit fox habitat identified as “good” quality falls within solar development and variance zones, 3.5% of desert kit fox habitat identified as “fair” falls within solar development and variance zones, and 4.4% of desert kit fox habitat identified as “marginal” falls within solar development and variance zones (see Table 3).

Of concern for the desert kit fox, solar development and variance areas and wind application areas overlap 13 of the 16 movement corridors that were identified as areas of high importance for kit fox habitat connectivity by Penrod et al. (2012) (see Figure 6).

Table 3. Large-scale solar development siting in desert kit fox habitat on public lands.
Sources: GIS data for BLM Solar Program priority development and variance areas on public lands downloaded from http://solareis.anl.gov/maps/gis/index.cfm, habitat data based on Figure 2.

<table>
<thead>
<tr>
<th>Habitat suitability index (model values)</th>
<th>Habitat amount (acres)</th>
<th>Solar variance areas (acres)</th>
<th>Solar variance areas in desert kit fox habitat (% of total habitat type)</th>
<th>Solar developmenet areas (acres)</th>
<th>Solar development areas in desert kit fox habitat (% of total habitat type)</th>
<th>Solar exclusion areas (acres)</th>
<th>Solar exclusion areas in desert kit fox habitat (% of total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good (8.8-9)</td>
<td>9,311,320</td>
<td>409,958</td>
<td>4.4</td>
<td>84,645</td>
<td>0.9</td>
<td>399,715</td>
<td>4.3</td>
</tr>
<tr>
<td>Fair (7.3-8.8)</td>
<td>1,910,000</td>
<td>64,738</td>
<td>3.4</td>
<td>1,725</td>
<td>0.1</td>
<td>76,985</td>
<td>4.0</td>
</tr>
<tr>
<td>Marginal (6.5-7.3)</td>
<td>5,466,340</td>
<td>188,061</td>
<td>3.4</td>
<td>41,134</td>
<td>0.8</td>
<td>77,677</td>
<td>1.4</td>
</tr>
<tr>
<td>Non-Habitat (0-6.5)</td>
<td>8,004,400</td>
<td>72,321</td>
<td>0.9</td>
<td>26,137</td>
<td>0.3</td>
<td>33,772</td>
<td>0.4</td>
</tr>
<tr>
<td>Total good, fair, and marginal habitat</td>
<td>16,687,660</td>
<td>662,757</td>
<td>4.0</td>
<td>127,505</td>
<td>0.8</td>
<td>554,377</td>
<td>3.3</td>
</tr>
</tbody>
</table>

The BLM’s Solar Program ROD also adopted exclusion areas for solar development. Exclusions including areas of critical habitat for USFWS designated threatened and endangered species, Desert Wildlife Management Areas, Flat tailed horned lizard habitat, and Mojave ground squirrel habitat (BLM & DOE 2012b). However, only 3% of desert kit fox
habitat (habitat identified as good, fair, or marginal quality in Figure 2) is excluded from solar development by the BLM Solar Program ROD. As a result, the protections for other desert wildlife do not adequately protect habitat areas that are essential for desert kit fox or for habitat connectivity.

**Figure 6: BLM Solar Program priority development, variance, and exclusion areas, wind application areas, and important kit fox movement corridors.**

ii. Impacts to the desert kit fox from large-scale solar energy development

Large-scale, solar energy developments, and their associated transmission lines and roads, pose a range of direct and indirect threats to the desert kit fox and their prey species, especially in case of multiple projects in proximity to each other. According to the Solar Program Final Environmental Impact Statement (“FPEIS”), “[n]umerous wildlife species would be adversely affected by loss of habitat, disturbance, loss of food and prey species, loss of breeding areas, effects on movement and migration, introduction of new species, habitat fragmentation, and changes in water availability. Impacts potentially could be dispersed across the 19 million acres of variance areas” (BLM and DOE 2012).

The direct and indirect impacts highlighted in environmental assessments for individual large-scale solar projects include habitat loss and degradation, displacement, disturbance to pup-rearing, increased mortality, injury, and harassment, reduced ability for movement, increased risk of predation, and habitat alteration:

Potential direct impacts on desert kit foxes from the construction and operation of the facility would include habitat loss; mortality, injury, or harassment of individuals as a result of encounters with vehicles or heavy equipment; disturbance from increased vehicular and human presence on the project site; and displacement due to habitat loss or alteration. Their tendency to seek shelter in burrows increases the likelihood that individuals could be injured or killed during ground-disturbing activities. Construction activities could also result in the disturbance of kit fox maternity dens during the pup-rearing season (February 15 to July 1).

As noted for other wildlife species and badgers, above, the dispersal of kit foxes would likely be hindered by tortoise exclusion fencing that would enclose the project site (i.e., a chain link fence and a tortoise exclusion fence). The BLM concludes that on-site habitat for kit foxes would not be maintained over time; therefore, 8,230 acres of potential kit fox habitat would be lost with construction of the Proposed Project. Individuals that remain in the immediate project vicinity could suffer from reduced productivity and survivorship as a result of construction-related and ongoing noise and visual disturbance.

Indirect impacts on this species would consist primarily of ongoing project-related disturbance and habitat degradation from the compaction of soils, introduction or spread of nonnative or invasive plant species, and the loss or alteration of its prey base. Another indirect impact would be the increased risk of predation from the placement of fencing, transmission towers, and other aboveground structures (e.g., SunCatchers) that would provide roosting opportunities for avian predators. (Calico Solar Project 2010).

Similarly, the California Energy Commission has found that large-scale solar energy projects pose potential direct impacts to the desert kit fox from “mechanical crushing of individuals or burrows by vehicles and construction equipment, noise, dust, and loss of habitat. The tortoise exclusion fence is expected to entrap desert kit foxes or even badgers if either species is on the site when the fence is built. Animals trapped within the fence would
almost surely die from direct or indirect effects of project construction (e.g., vehicle strike, inability to find sufficient food or thermal cover).” Potential indirect and off-site impacts include “construction and operational noise and disturbance, impediments to local or regional movement, alteration in prey base, introduction or spread of invasive plants, and risk of mortality by vehicle strikes.” (Rice Solar Energy Project 2010).

As detailed below, key threats from large-scale industrial solar development to the desert kit fox include habitat loss, degradation, fragmentation, and loss of connectivity, as well as direct and indirect impacts resulting from reduced ability for movement, increased competition and depredation, increased in non-native cover, mortality from roads, and displacement of foxes from den sites:

(a) Loss of habitat: Both public and private land large-scale solar development sites on previously undisturbed habitat in the range of the desert kit fox are graded to varying degrees and securely fenced facilities to prevent vandalism and preclude sensitive species from accessing the site. The grading and effectively eliminates on-site habitat for the desert kit fox.

(b) Reduced ability for movement: The fenced solar sites, if inappropriately sited or aggregated in an area, create large blocks of inaccessible habitat, and if large enough, can eliminate or degrade movement corridors for kit fox. Even with a partial blockage, kit foxes are forced to circumnavigate the boundary of solar site. Connectivity between populations of kit foxes is critical for maintaining genetic integrity of the population and safeguarding populations over the long-term.

(c) Increased habitat fragmentation: Development of large-scale industrial solar facilities in areas without other development fragments intact desert habitat for the kit fox. Habitat fragmentation is a documented factor in the decline of kit foxes (Moehrenschlager et al. 2004).

(d) Increased competition for resources: Forcing on-site foxes off-site can increase competition between the displaced foxes and resident foxes, where the displaced foxes are disadvantaged due to unfamiliarity with the landscape in finding food, water, and shelter sites. In addition, it is likely that forcing displaced kit foxes into resident kit fox territories sets up territorial dynamics that are disadvantageous to the displaced kit foxes.

(e) Increased predation: As with any industrial development located in otherwise undisturbed habitat, the potential for subsidizing predators increases due to the increase in availability of resources. At large-scale solar facilities, the potential increase in availability of water and food may increase the population of coyotes. Intraguild predation by coyotes on kit foxes is a documented cause of kit fox mortality (Moehrenschlager et al. 2004).

(f) Increases in non-native cover: Disturbance of intact habitats provides the opportunity for colonization of the disturbed area by non-native plant species in the California deserts (Brooks and Pyke 2001, Brooks and Lair 2005, Brooks et al. 2006). The non-native plants do not provide adequate forage for prey species for kit foxes and therefore reduce the resources and carrying capacity of the landscape for kit foxes (Moehrenschlager et al. 2004)
(g) Road-building leading to increased mortality: Collisions with vehicles are an important source of mortality for kit foxes, and in some areas are responsible for over 10% of the total kit fox mortality (Moehrenschlager et al. 2004: 195). New roads are a necessary component of most large-scale industrial solar projects and also increase the opportunity for illegal route proliferation to occur off project roads. Increases in the number of roads will increase the vulnerability of kit foxes to mortality from roadkill.

(h) Displacement of kit foxes from dens on large-scale energy development project sites: In order to comply with Title 14 of the California Code of Regulations § 460 which prohibits the take of the desert kit fox, the California Energy Commission has required that desert kit foxes be “passively relocated” from large-scale renewable energy development sites for projects that the CEC approved. The typical procedure to comply with this regulation involves (1) preconstruction surveys for desert kit fox burrows, complexes, and other signs on the project site and a buffer zone around it, and (2) “passive relocation” of foxes from the project site. In order to facilitate passive relocation of kit foxes outside the project’s temporary fencing, the following procedures that were implemented by the Genesis Solar Project (CEC 2011, Genesis Solar 2012) are one example of the measures that might be undertaken by large-scale solar energy projects in California:

(a) removal of the primary sources of food and cover through on-site mowing which was required as part of the unexploded ordnance surveys;
(b) installation of temporary ramps over tortoise fencing to encourage crossing;
(c) the use of coyote urine, a primary kit fox predator, around burrow entrances, and the use of a wooden lathe in the burrow entrance center to discourage use of the burrow;
(d) use of one-way doors on desert kit fox burrows entrances; and
(e) collapse of active burrows after no activity is observed for three consecutive days.

Many of these passive relocation measures have the potential to harm kit foxes by forcing them to establish new territories and dens in areas outside of the project site that may be less optimal or already occupied. In addition, some kit foxes repeatedly try to return to their onsite territories which can cause stress to foxes as they try to create new dens, avoid humans, and search for food on the project site. Foxes have been observed climbing eight-foot chain link fences and crossing electrified fencing to return to their territories. As summarized by the Preliminary Staff Assessment (PSA) for the Hidden Hills Solar Energy Generating System (CEC 2012b):

Rather than establish new permanent offsite territories, some kit fox remain onsite, digging new burrows overnight, or possibly moving briefly offsite, only to emigrate back. This results in ongoing stress to kit fox in attempting to search out and/or create new dens onsite repeatedly, avoid humans, and find prey… Successful eviction of kit fox, burrowing owl, and badger has been a continuing concern on large solar projects. At the Ivanpah Electric Generating System project, kit fox have been observed climbing eight foot chain link fence (Douglas & Davis pers. comm. 2012)... On the Genesis Solar Electric Generating Project (GSEP), the use of electrified fencing added to project perimeter fencing has also failed to deter kit fox from entering and exiting the site on a daily basis (GSEP Monthly Compliance Report 2012) (CEC 2012: 4.2-98).
The PSA also suggests that night lighting could be disruptive to desert kit foxes due to their nocturnal behavior (CEC 2012b).

These reports clearly illustrate that assessment and mitigation of the impacts of large-scale solar energy development on desert kit foxes is not comprehensive as there are still gaps in data, unpredicted impacts, an absence of efforts to avoid impacts to kit fox, and failures of mitigation methods. There are also less understood indirect threats to the population from large-scale solar energy development on previously undisturbed desert lands, as demonstrated by an outbreak of canine distemper clustered around the Genesis Solar project beginning in 2011 (see Anthropogenic Disease Risk section below). The occurrence of a canine distemper outbreak in relation to solar development was unforeseen by environmental impact assessments, and there is still uncertainty as to the cause of the outbreaks. The Final Staff Assessment (FSA) of the Hidden Hills Solar Energy Generating System, which was written after the distemper outbreak was reported, notes the direct impacts of this project to be “potential mortality or disturbance during construction and operation, loss or fragmentation of habitat, displacement, disruption of movement. Potential disturbance from passive relocation including mortality and spread of disease” (CEC 2012a at 4.2-74).

b. Large-scale industrial wind energy developments

i. Increases in large-scale industrial wind energy developments in desert kit fox habitat

Large-scale industrial wind energy developments in the California desert region have also been experiencing sudden and rapid growth, as illustrated by Tables 4, 5, and 6 which summarize the number of wind energy applications and authorizations since 2006 (BLM 2012b). The summary includes applications filed with the Bureau of Land Management in the California Desert Conservation Area with jurisdiction over large areas of desert kit fox habitat and private land development in Kern County within kit fox habitat. As of January 2013, eleven wind energy projects covering almost 75,000 acres (12,436 acres on public land, 62,310 acres on private land) have been approved with many of them in the construction phase (Table 4). Three additional projects covering 16,611 acres are currently under environmental review (Table 4). In addition, twenty-seven wind projects are authorized to do wind testing on almost 270,000 acres of public land (Table 5). Another forty wind project applications are in development or propose testing, covering an additional 485,000 acres of public land (Table 6). The potential cumulative development for wind in desert kit fox habitat could cover close to 850,000 acres, primarily on public land. As noted in Table 4, most approved and in-review wind development sites have documented presence of desert kit foxes and/or suitable habitat, and projects that have not found desert kit fox presence typically have not conducted species-specific surveys.
Table 4: Approved and in-review large-scale industrial wind energy developments in desert kit fox habitat, and occurrence and management of desert kit foxes per project. Table includes the project name, county (including location on public or private land), status, size, and documented occurrence and management measures for desert kit fox for each project.
Source: BLM\textsuperscript{9} and Kern County\textsuperscript{10}.

<table>
<thead>
<tr>
<th>Name</th>
<th>County</th>
<th>Status</th>
<th>Size (acres)</th>
<th>Occurrence and management of desert kit foxes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocotillo Express</td>
<td>Imperial</td>
<td>Approved</td>
<td>12,436</td>
<td>Desert kit fox observed on site (Ocotillo Express 2011a), but desert kit fox presence, impacts, and mitigation not addressed in FEIS/EIR (<a href="http://www.blm.gov/ca/st/en/fo/elcentro/nepa/ocotillo_express_wind.html">http://www.blm.gov/ca/st/en/fo/elcentro/nepa/ocotillo_express_wind.html</a>).</td>
</tr>
<tr>
<td>Alta</td>
<td>Kern</td>
<td>Approved</td>
<td>13,785</td>
<td>No surveys for desert kit fox and not addressed in DEIR; Response to Comments requires pre-construction surveys and monitoring of excavation (Alta Wind Energy 2011).</td>
</tr>
<tr>
<td>Alta Infill II</td>
<td>Kern</td>
<td>Approved</td>
<td>5,185</td>
<td>No surveys for desert kit fox and not addressed in DEIR; Response to Comments requires pre-construction surveys and monitoring of excavation (Alta Wind Energy 2011).</td>
</tr>
<tr>
<td>Catalina</td>
<td>Kern</td>
<td>Approved</td>
<td>7,440</td>
<td>No species specific surveys, but habitat is known to support desert kit fox; Response to Comments requires pre-construction surveys and avoidance of occupied kit fox dens in consultation with the California Department of Fish and Game (Catalina Wind Energy 2011).</td>
</tr>
<tr>
<td>North Sky River</td>
<td>Kern</td>
<td>Approved</td>
<td>12,781</td>
<td>Desert kit fox presence and suitable habitat documented on site; requires pre-construction surveys, temporary avoidance of maternity dens, passive relocation (North Sky River and Jawbone 2011).</td>
</tr>
<tr>
<td>Morgan Hills</td>
<td>Kern</td>
<td>Approved</td>
<td>3,604</td>
<td>No analysis of desert kit fox presence; requires that written documentation of kit fox removal be provided to California Department of Fish and Game and Kern County within 30 days of relocation (Morgan Hills Wind 2011).</td>
</tr>
<tr>
<td>Lower West Wind</td>
<td>Kern</td>
<td>Approved</td>
<td>1,007</td>
<td>No species specific surveys; desert kit fox not observed but expected to be present; no mitigation required (Lower West Wind 2011).</td>
</tr>
<tr>
<td>Pacific Wind</td>
<td>Kern</td>
<td>Approved</td>
<td>8,300</td>
<td>No species specific surveys; desert kit fox not recorded but suitable habitat present; requires preconstruction surveys, temporary avoidance of maternity dens, passive relocation (Pacific Wind Energy 2010).</td>
</tr>
<tr>
<td>Pacific Wind</td>
<td>Kern</td>
<td>Approved</td>
<td>1,325</td>
<td>No species specific surveys; desert kit fox not</td>
</tr>
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</table>

\textsuperscript{10}http://pcd.kerndsa.com/planning/environmental-documents
<table>
<thead>
<tr>
<th>Project Name</th>
<th>County</th>
<th>Project Type</th>
<th>Size (Acres)</th>
</tr>
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<tbody>
<tr>
<td>Power Partners Troy Lake Type II</td>
<td>San Bernardino</td>
<td>Testing</td>
<td>10,154</td>
</tr>
<tr>
<td>Sierra Renewables Black Lava Butte Type II</td>
<td>San Bernardino</td>
<td>Testing</td>
<td>4,030</td>
</tr>
<tr>
<td>EC&amp;R West North Peak Type II</td>
<td>San Bernardino</td>
<td>Testing</td>
<td>15,385</td>
</tr>
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</table>

Table 5. BLM authorizations for wind testing on public lands
Source: BLM website

---

<table>
<thead>
<tr>
<th>Project Name</th>
<th>County</th>
<th>Project Type</th>
<th>Size (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granite Wind</td>
<td>San Bernardino</td>
<td>Development</td>
<td>2,086</td>
</tr>
<tr>
<td>Silurian Valley Wind</td>
<td>San Bernardino</td>
<td>Development</td>
<td>6,720</td>
</tr>
<tr>
<td>Oro Grande Wind</td>
<td>Imperial</td>
<td>Development</td>
<td>10,907</td>
</tr>
<tr>
<td>Tylerhorse Wind</td>
<td>Kern</td>
<td>Development</td>
<td>1,520</td>
</tr>
<tr>
<td>Total: 4 projects in Development</td>
<td></td>
<td></td>
<td>21,233</td>
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</table>

**Table 6. Applications for large-scale industrial wind energy project developments on public lands**

Source: BLM website[^13]

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Type</th>
<th>Location</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fairview Type II</td>
<td>II</td>
<td>San Bernardino</td>
<td>10,542</td>
</tr>
<tr>
<td>Lydia Wind Type II</td>
<td>II</td>
<td>San Bernardino</td>
<td>17,011</td>
</tr>
<tr>
<td>Meridian Type II</td>
<td>II</td>
<td>San Bernardino</td>
<td>44,245</td>
</tr>
<tr>
<td>Calico Type II</td>
<td>II</td>
<td>San Bernardino</td>
<td>28,908</td>
</tr>
<tr>
<td>North Calico Type II</td>
<td>II</td>
<td>San Bernardino</td>
<td>5,000</td>
</tr>
<tr>
<td>Alvord Mountains Type II</td>
<td>II</td>
<td>San Bernardino</td>
<td>5,000</td>
</tr>
<tr>
<td>John Peterson (1)</td>
<td>II</td>
<td>Imperial</td>
<td>4,435</td>
</tr>
<tr>
<td>John Peterson (2)</td>
<td>II</td>
<td>Imperial</td>
<td>6,780</td>
</tr>
<tr>
<td>Candlewood Power El Centro Type II</td>
<td>II</td>
<td>Imperial</td>
<td>3,199</td>
</tr>
<tr>
<td>Renewery Type II</td>
<td>II</td>
<td>San Bernardino</td>
<td>37,219</td>
</tr>
<tr>
<td>Homer Renewables Type II</td>
<td>II</td>
<td>San Bernardino</td>
<td>18,852</td>
</tr>
<tr>
<td>Element Type II</td>
<td>II</td>
<td>San Bernardino</td>
<td>8,000</td>
</tr>
<tr>
<td>Sawtooth Type II</td>
<td>II</td>
<td>San Bernardino</td>
<td>18,240</td>
</tr>
<tr>
<td>Arrowhead Type II</td>
<td>II</td>
<td>San Bernardino</td>
<td>18,560</td>
</tr>
<tr>
<td>Bristol Lake Type II</td>
<td>II</td>
<td>San Bernardino</td>
<td>22,000</td>
</tr>
<tr>
<td>Siberia Type II</td>
<td>II</td>
<td>San Bernardino</td>
<td>30,460</td>
</tr>
<tr>
<td>Searles Hill</td>
<td>II</td>
<td>San Bernardino</td>
<td>2,616</td>
</tr>
<tr>
<td>Graham Pass Type II</td>
<td>II</td>
<td>Riverside</td>
<td>30,855</td>
</tr>
<tr>
<td>LH Renewables Riverside County Type II</td>
<td>II</td>
<td>Riverside</td>
<td>2,698</td>
</tr>
<tr>
<td>PG&amp;E Type II</td>
<td>II</td>
<td>Riverside</td>
<td>6,120</td>
</tr>
<tr>
<td>Johnson Wind Power Type II</td>
<td>II</td>
<td>Riverside</td>
<td>275</td>
</tr>
<tr>
<td>Aero Power Type II</td>
<td>II</td>
<td>Riverside</td>
<td>2,994</td>
</tr>
<tr>
<td>LH Renewables Type II</td>
<td>II</td>
<td>Riverside</td>
<td>19,214</td>
</tr>
<tr>
<td>Little Lake Type II</td>
<td>II</td>
<td>Inyo</td>
<td>8,835</td>
</tr>
<tr>
<td>AES Type II</td>
<td>II</td>
<td>Kern</td>
<td>139</td>
</tr>
<tr>
<td>Sierra Type II</td>
<td>II</td>
<td>Kern</td>
<td>7,881</td>
</tr>
<tr>
<td>Mojave Diamonds Type II</td>
<td>II</td>
<td>Kern</td>
<td>5,256</td>
</tr>
<tr>
<td>Vincent Type II</td>
<td>II</td>
<td>Kern</td>
<td>1,158</td>
</tr>
<tr>
<td>Piper Type II</td>
<td>II</td>
<td>Kern</td>
<td>10,029</td>
</tr>
<tr>
<td>Willow Springs Type II</td>
<td>II</td>
<td>Kern</td>
<td>1,444</td>
</tr>
<tr>
<td>Pacific Wind Red Mountain Type II</td>
<td>II</td>
<td>Kern</td>
<td>24,693</td>
</tr>
<tr>
<td>El Paso Mountains Type II</td>
<td>II</td>
<td>Kern</td>
<td>3,164</td>
</tr>
<tr>
<td>Ridgeline Red Mountain Type II</td>
<td>II</td>
<td>Kern</td>
<td>4,500</td>
</tr>
<tr>
<td>New Dimension Kern County Type II</td>
<td>II</td>
<td>Kern</td>
<td>4,651</td>
</tr>
<tr>
<td>Jawbone Canyon Type II</td>
<td>II</td>
<td>Kern</td>
<td>47,226</td>
</tr>
<tr>
<td>Short Canyon Type II</td>
<td>II</td>
<td>Kern</td>
<td>1653</td>
</tr>
<tr>
<td><strong>Total: 36 Testing Type II applications</strong></td>
<td></td>
<td></td>
<td><strong>463,932</strong></td>
</tr>
<tr>
<td><strong>Total: 40 Testing and Development</strong></td>
<td></td>
<td></td>
<td><strong>485,165</strong></td>
</tr>
</tbody>
</table>
We conducted an analysis to determine the percentage of desert kit fox habitat that falls within the wind application areas on public lands (see Figure 6). The results of this analysis (Table 7) shows that almost 4% of desert kit fox habitat ranked as “good,” “fair,” or “marginal” falls within wind application areas, which does not include habitat on private land wind developments that currently comprises more than 62,000 acres of approved projects and nearly 17,000 acres of projects under review. As noted above, solar development and variance areas and wind application areas overlap 13 of the 16 movement corridors that were identified as areas of high importance for kit fox habitat connectivity by Penrod et al. (2012) (see Figure 6).

Table 7. Large-scale industrial wind application areas in desert kit fox habitat on public lands.
This table does not include wind development on private lands in desert kit fox habitat.
Sources: GIS data for wind application areas downloaded from http://www.blm.gov/ca/gis/; habitat data based on Figure 2.

<table>
<thead>
<tr>
<th>Habitat suitability index (model values)</th>
<th>Habitat amount (acres)</th>
<th>Wind application areas (acres)</th>
<th>Wind application areas in desert kit fox habitat (% of total habitat type)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good (8.8-9)</td>
<td>9,311,320</td>
<td>356,835</td>
<td>3.8</td>
</tr>
<tr>
<td>Fair (7.3-8.8)</td>
<td>1,910,000</td>
<td>55,368</td>
<td>2.9</td>
</tr>
<tr>
<td>Marginal (6.5-7.3)</td>
<td>5,466,340</td>
<td>226,025</td>
<td>4.1</td>
</tr>
<tr>
<td>Non-Habitat (0-6.5)</td>
<td>8,004,400</td>
<td>152,240</td>
<td>1.9</td>
</tr>
<tr>
<td>Total good, fair, and marginal habitat</td>
<td>16,687,660</td>
<td>790,468</td>
<td>3.8</td>
</tr>
</tbody>
</table>

ii. Impacts to the desert kit fox from large-scale industrial wind energy developments

As illustrated in Figure 6 and summarized by Table 7, a rapidly increasing number of large-scale industrial wind energy projects are being located in desert kit fox habitat, including modeled habitat connectivity corridors. As a result, desert kit foxes face growing threats of habitat loss and degradation, displacement, entombment, and reduced connectivity due to large-scale industrial wind energy development. Even the wind energy testing sites involve road building, clearing and grading for installation of monitoring towers and equipment. Construction of full-scale wind energy projects involves road building to each individual tower, clearing, excavation, blasting, trenching, grading, and heavy vehicle traffic, causing significant alteration of the landscape (TEEIC 2012), which results in loss and degradation of habitat for the desert kit fox. Other impacts due to on-site operations include increase risk of roadkill, poisoning, and disturbance. Indeed desert kit fox mortality has been documented on the Ocotillo Express project site due to drowning in one of the on-site water reservoirs used for construction (BLM 2012).

The direct and indirect impacts of wind energy developments are highlighted in the environmental analyses for many wind projects:
Potential direct impacts to desert kit fox include mechanical crushing of individuals or burrows by vehicles and construction equipment, entombment within burrows, noise, dust, and loss of habitat. Potential indirect impacts include alteration of soils, such as compaction that could preclude burrowing, and the spread of exotic weeds. Potential operational impacts include risk of road kill on access and spur roads by maintenance personnel, the spread of noxious weeds, and disturbance due to increased human presence. These species could also be subject to poisoning if chemical rodent control is used. Construction activities including clearing and grading of WTG sites, staging areas, substation locations, and access roads could result in mortality of individual foxes or disturbance of maternity dens during the pup-rearing seasons (February 15 to July 1). (North Sky River and Jawbone Wind Energy Project 2011).

Of concern for the desert kit fox, the environmental reviews for large-scale wind energy developments have not adequately considered or mitigated for the impacts of the projects on the desert kit fox and its habitat. Many projects do not conduct species-specific surveys for the desert kit fox. When desert kit foxes have been detected, no efforts are made to avoid impacts to the species and its habitat and mitigation measures are inadequate. For example, desert kit foxes and kit fox dens were detected on the Ocotillo Wind Energy project site that recently began operations. The response to a comment on the Draft EIS/EIR for the Ocotillo Wind Express project stated that discussion of impacts to desert kit fox are not required for the EIS/EIR “because the species is not considered a special status animal species as defined in Section 3.23.1.1 of the Draft EIS/EIR and the potential impacts to the species would not be considered significant in accordance with the CEQA Significance Criteria as defined in Section 4.21.2” (BLM 2012c). In those cases were the approvals for wind projects require mitigation, mitigation measures have included pre-construction surveys, temporary avoidance of maternity dens, and passive relocation from non-maternity dens. As a result, wind development projects ultimately result in the destruction of habitat on the project site and increased habitat disturbance adjacent to the site, displacement of foxes, disruption of movement, and increased risk of stress and mortality. These impacts may have significant local population effects and cumulative regional effects, which are not being properly analyzed, avoided, minimized or mitigated.

In short, the lack of consideration given to the desert kit fox by large-scale renewable energy projects such as the Ocotillo Wind Energy project and the unpredictable impacts of renewable energy development on the kit fox - as demonstrated by the canine distemper outbreak at Genesis Solar – clearly indicates that the threats to desert kit fox are inadequately accounted for by current regulations and procedures.

c. Threats from roads and transmission lines associated with large-scale renewable energy development

Large-scale industrial energy development in the California deserts leads to an increase in linear corridors that are created by new roads and transmission lines. As summarized by Swartley (2010: 41-42), transmission lines and associated roads result in a suite of negative impacts, including habitat loss, degradation, and fragmentation. “Soil disturbance during construction of transmission lines allows the intrusion of invasive plant species and contributes to soil erosion. When transmission lines are first constructed, the recovery of the disturbed land is gradual. Immediately following construction, invasive
ephemeral plant species inhabit the area, but perennial plant species could not return for more than five years after. Increased human access via roads accompanying transmission lines can hinder plant growth and deter animals from inhabiting the corridor.”

2. Anthropogenic disease risks

An outbreak of canine distemper in desert kit foxes centered at the Genesis solar project site in the Mojave Desert in 2011 raises the concern that disease may pose a significant threat to the desert kit fox in California. Diseases are not typically a major source of mortality in kit foxes in California (O’Farrell and Gilbertson 1986, Cypher et al. 2000). However, anthropogenic disturbances in the ecosystem can cause outbreaks of disease that threaten the survival of fox populations. For example, the introduction of domestic dogs to Santa Catalina Island caused an outbreak of canine distemper that ravaged the local population of Island Foxes (Coonan 2003). An outbreak of rabies virus is purported to have contributed to the catastrophic decline of kit foxes at the California Army National Guard Training Site at Camp Roberts (White et al. 2000). For the desert kit fox, infrastructure development in areas inhabited by foxes, such as that from energy projects, causes habitat loss, degradation, and stressful environments which can predispose them to diseases.

Canine distemper (CD) is a disease caused by a virus belonging to the *Morbillivirus* genus, affecting several families of animals, including Canidae, Mustelidae, Mephitidae, Procyonidae, and Felidae (Deem et al. 2000). The distemper virus is ubiquitous in dog populations, and also affects some populations of wildlife (Ibid). The disease is enzootic in some populations, and has caused precipitous population declines in others, such as black-footed ferrets in Wyoming, and lions in Serengeti National Park (Williams et al. 1988, Roelke-Parker et al. 1996). The virus is also readily transmitted between species, whether wild or domestic (Harder and Osterhaus 1997).

Although there is very little known about the impacts of CD in animal populations within the Mojave desert, the disease has been reported in species that are present in the Mojave (Cypher et al. 1998). Desert kit foxes are not just directly threatened by the factors that predispose them to infection by CD, such as stress and the introduction of dogs; the same factors may also cause the spread of the disease in other species that can in turn infect desert kit foxes. Riley et al. (2004) reported a widespread outbreak of canine distemper in gray foxes in Marin County, California. The study suggested that a lack of herd immunity against the disease predisposed the gray foxes to the outbreak, as no foxes tested positive for exposure to the virus in the years preceding the outbreak (Riley et al. 2004). Harris and Ogan (1997) reported a similar outbreak of distemper in a gray fox population along the central coast of California, and the population was subsequently unable to recover in the face of coyote recolonization. It is unknown how the coyote population in the Mojave would respond in a similar situation. Davidson et al. (1992) studied diseases in gray foxes from the southeastern United States and concluded that canine distemper is a more significant cause of mortality in the foxes than all other infectious and noninfectious diseases combined. CD has also been detected in free-ranging coyote populations in California, Arizona, Wyoming, Colorado, and Texas (Guo et el. 1986, Gese et al. 1991, Gese et al. 1997, Cypher et al. 1998, Grinder and Krausman 2001). Coyote populations are known to overlap with desert kit foxes in the Mojave Desert, presenting strong potential for transmission of disease.

The canine distemper virus is transmitted by direct contact with aerosol or body fluids from infected animals during the acute phase of the disease. It can also rarely be spread by
food and water contaminated with infected fluids, or even by humans and their equipment (Crownright-Snoeren 2010). The cool, moist interiors of kit fox burrows, in addition to the foxes’ enthusiastic grooming behavior, may aid the persistence and spread of the virus in the harsh desert climate of the Mojave.

In late 2011, an outbreak of canine distemper emerged in the desert kit fox population at the Genesis solar project site in the Mojave Desert. The exact cause of the outbreak is still unknown. A veterinarian at the California Department of Fish and Game suggests that the two most likely reasons are either the introduction of a virulent strain of the virus by domestic dogs or other carnivores, or stress caused by the construction activity at Genesis that made the foxes more susceptible to full-blown cases of distemper (Sahagun 2012).

The focus of the desert kit fox outbreak as well as the first recorded death occurred at the site of the Genesis solar project, 25 miles west of Blythe (Clifford et al. 2012). In order to haze the foxes from the Genesis construction site, “workers removed sources of food and cover, sprinkled urine from coyotes — a primary fox predator — around den entrances, and used shovels and axes to excavate about 20 dens that had been unoccupied for at least three consecutive days” (Sahagun 2012). By summer 2012, 9 deaths due to distemper had been confirmed (Clifford et al. 2012). The California Department of Fish and Game responded to the first deaths by studying kit foxes at four different sites around the original site of the outbreak. Biological samples were collected from 39 foxes. Immunological tests confirmed recent exposure of living kit foxes to the virus, based on the detection of antibodies in their blood samples. DNA sequencing revealed active viral shedding in some of the foxes, which occurs during the acute phase of the disease. Exposure to CD as indicated by antibodies to the virus in blood samples was detected in foxes as far as 40 km northwest of the origin of the outbreak. Most distemper deaths were recorded around the site of the Genesis project, but some occurred at a site 19 km southeast of Genesis, demonstrating that the virus was not contained at the focus of the outbreak. Canine distemper is not a significant cause of mortality in wild adult canines that are exposed to the virus in populations where the disease is endemic (Cleaveland et al. 2000, Grinder and Krausman, 2001). Deaths in adult desert kit foxes therefore suggest that were immunologically naïve to the disease prior to the outbreak. Recovery of the bodies of foxes dying from distemper may be difficult in the case of animals that die deep in their dens. This underscores the fact that the impacts of the disease on the young foxes born after the outbreak began is impossible to estimate, as any deaths of nursing young would most likely occur in burrows.

Unlike the case of the distemper outbreak in Island foxes on San Catalina Island, it is not possible to curtail the spread of the disease in desert kit foxes by vaccination. Firstly, desert kit foxes occur in unrestricted habitat as opposed to Island foxes, and their movements in the affected area have not been studied. Secondly, the size of the population is unknown, and without this information it is not possible to know how many foxes must be vaccinated in order to achieve the minimum number of immune individuals to protect the population from the disease. These reasons underscore the increased vulnerability of desert kit foxes caused by the lack of baseline data.

3. **Roads and off-road vehicles**

Vehicular routes have been noted as one of the most intense and pervasive form of anthropogenic disturbance in the Mojave Desert (Brooks and Lair 2005). The major
highways traversing the Mojave Desert are the I-15, I-40 and I-10, and road networks also connect military areas, and renewable energy sites, among other infrastructure (Figure 7).

With the development of potentially hundreds of thousands of acres of large-scale industrial renewable energy projects as well as transmission lines and roads that are required for energy infrastructure, hundreds of thousands of acres that were previously unavailable to off-road vehicle access will be available to them. New roads will provide new opportunities for illegal route proliferation that further degrade habitat and impact desert kit foxes.

Figure 7: Map of California desert roads within the desert kit fox range
While kit foxes are known to be able to successfully traverse major roads (Cypher 2009), vehicles are documented to be an important source of mortality for kit fox, and in some areas are responsible for over 10% of the total kit fox mortality (Moehrenschlager et al. 2004: 195). Deaths caused by vehicular impacts may not be a significant source of mortality in stable core populations of kit foxes, but they are an inevitability that can threaten small populations (Bjurlin et al. 2005). Apart from the threats of death from vehicle collisions and habitat loss, roads cause habitat fragmentation and habitat degradation in adjacent areas. The potential effects of roads on San Joaquin kit foxes suggested by Bjurlin et al. (2005) are mortality, morbidity, disrupted social ecology, reduced productivity, displacement, altered space use, inhibited dispersal, reduced genetic exchange, and decreased carrying capacity. Also, most road construction activity occurs during the day when desert kit foxes rest in their dens. This puts them at risk for entombment due to cave-ins if proper clearance protocols are not followed before construction.

Vehicular pathways are also an important source of the spread of invasive plant species in desert environments (Webb et al. 2009). The passage of vehicles along these routes causes increases in the levels of soil moisture and mineral nutrients in the areas alongside. These factors allow the persistence of invasive species along roadways during periods of drought that may have otherwise eliminated them (Ibid). The periodic blading of dirt roads creates deep, loose soil in berms and shoulders that can facilitate the spread of invasive plant species. The alteration of vegetation cover can affect the desert kit fox prey base of small mammals (Ibid). This is concerning as kit fox populations are known to be closely tied to the variations in their primary prey populations (Cypher 2003). Populations of ground squirrels, for example, varied both positively and negatively with vehicular pathways in the Mojave according to the amount of rainfall received that year (Webb et al. 2009). These complex ecological interactions caused by roadways have unknown impacts on desert kit foxes. Kangaroo rats are the primary prey of desert kit foxes, and the soil compaction and auditory disturbance caused by off-road vehicles have been found to negatively impact kangaroo rat populations (Goldingay et al. 1997).

Another threat presented by major roads is the significant amount of air pollution created by heavy traffic. This creates a gradient of heavy metals in the soil and plants along the route. Animals that consume these plants can start a chain of bioaccumulation of heavy metals in desert animals including kit foxes. This is a significant concern as increased levels of heavy metals can reduce lifespans and reproductive rates in mammals (Webb et al. 2009). Utility lines that are frequently installed along major roads can serve as nesting and perching sites for raptors and owls. This can negatively impact desert kit foxes by increasing the incidence of predation on kit foxes and increasing inter-species competition for prey. Roads can also serve as travel corridors for kit fox predators and competitors (Bjurlin et al. 2005).

The Mojave Desert alone attracts two million off-road vehicle visitors annually (Bunn et al. 2007). According to the BLM, most of the recreation areas for off-road vehicles in the Western Mojave are within creosote bush scrub, desert wash, and saltbush scrub communities (BLM 2003). Creosote bush scrub is the preferred habitat of desert kit foxes in the Mojave Desert.

Desert kit foxes are known to not be greatly disturbed by human presence but vehicles driving over kit fox burrows will inevitably cause cave-ins, and compaction of desert soil will render those areas uninhabitable to them. Off-road vehicles can also negatively impact desert kit foxes through indirect mechanisms. For example, it is suggested that the track created by a
single pass of an off-road vehicle on desert soil can create local depressions that can trap seeds and enhance the abundance of non-native species (Webb et al. 2009). Another concerning aspect of the threat to kit fox habitat from off-road vehicles is inadequate management. There are typically only two or three BLM rangers per million acres of the Mojave Desert, and recreational off-road vehicle users have been known to go off of designated routes and ride in areas that are not designated for off-road use (Bunn et al. 2007).

4. **Urbanization**

According to the BLM, the population of the western Mojave Desert has tripled over the last twenty years, and rapid growth is expected to continue over the next few decades. Urbanization causes direct loss of habitat and cumulative impacts from habitat fragmentation. The threat of urbanization to desert kit foxes is similar to that faced by the Mohave ground squirrel, i.e. “Large scale habitat destruction occurs in urban areas with the development of subdivisions, shopping malls, golf courses, aircraft runways, landfills, sewage disposal facilities, prisons, dikes and levees, etc” (DOW and Stewart 2005: 19). Another threat posed by urban areas is the disease risk they present due to the introduction of domestic dogs.

5. **Livestock grazing**

Grazing has altered the desert scrub ecosystems, reducing preferred native shrubs and herbaceous plants that support the small mammals that comprise prey species for the desert kit fox (Avery 1999 in Bunn et al. 2007). Heavy grazing also facilitates the spread of cheatgrass and other invasive annual grasses, replacing native grasses, herbs, and perennial shrubs, further diminishing habitat conditions for wildlife (Barbour et al. 1993 in Bunn et al. 2007). In turn, fires are more frequent where invasive annual grasses are abundant, preventing the natural restoration of native vegetation and further disturbing habitat for native wildlife. In 1994, nearly 60,000 Animal Unit Months (AUMs)\(^{15}\) for cattle and sheep were approved by BLM on 3.5 million acres of the Mojave Desert region spread across 25 allotments (Bunn et al. 2007). While some grazing has since been retired or reduced to limit impacts to species and habitats, livestock grazing can result in the introduction of large amounts of organic matter, such as hay, urine, and feces that can alter local vegetation composition (Ibid). Livestock can also collapse burrows when walking over them.

Grazing activity also requires artificial water sources to be created in areas that previously had no available water. This allows the incursion of coyote populations that are usually limited by the availability of water. Another threat arising from livestock watering sites is that they can serve as propague sources that enhance the spread of non-native species (Webb et al. 2009).

6. **Military use of kit fox habitat**

Two large expansions of military lands in desert kit fox habitat may significantly degrade these habitat areas and exclude kit foxes.


\(^{15}\) An animal unit month is defined as the amount of forage required to sustain one cow and calf or one horse or five sheep for one month.
(a) Fort Irwin Expansion: In 2006, the Department of Defense finalized a 132,250 acre expansion of the Fort Irwin National Training Center Military Base.\(^{16}\) The expansion area includes three areas adjacent to the existing Fort Irwin including the 63,673 acre Superior Valley unit, the 46,438 acre Eastgate unit, and the 22,139 acre UTM-90 unit. The Superior Valley and Eastgate areas were previously primarily BLM lands. The UTM-90 unit comprises BLM lands that had previously been set aside for the conservation of the state and federally threatened desert tortoise. Fort Irwin is an Army training facility that implements force-on-force and live fire training of heavy brigade-sized military forces, including tank training, armored vehicles and aircraft.\(^{17}\) This large-scale facility that includes tanks, armored vehicles, and live fire training will clearly displace desert kit fox from the area and likely cause direct mortality by being run over, entombed in burrows when the burrows are in the path of training vehicles, or from live-fire and bombing activities. The habitat will be degraded from the training activities and the habitat values that support kit fox will likely be locally extirpated.

(b) Marine Corps Air Ground Combat Center (MCAGCC) Twentynine Palms, California, Expansion: MCAGCC has finalized an environmental document that would allow an expansion of almost 168,000 acres onto BLM-managed lands in the central Mojave Desert.\(^{18}\) The expansion area includes 21,304 acres in the southern expansion area on the southern boundary of the existing base and a 146,667 acres in the western expansion of which 38,137 acres would be shared intermittently with off-road vehicle enthusiasts and the remaining 108,530 acres would be used exclusively by the Marine Corps. These expansion areas are located within existing habitat for the desert kit fox. The marine base expansion will facilitate training of three Marine brigades at a time (45,000 troops), and will include sustained combined-arms, live-fire and maneuver training along with command and support units, including tanks and armored vehicles maneuvers. As with Fort Irwin, this type of military training is incompatible with maintaining habitat for desert kit foxes and will lead to their local extirpation in the expansion area.

The western part of the expansion also includes part of the currently established Johnson Valley Off-Road Vehicle Open Area which includes approximately 189,000 acres. With the expansion of MCAGCC, the ORV open area would be reduced to a little over 42,000 acres (78% reduction). The closure of most of Johnson Valley off-road riding area to the public will likely displace off-road riding activities to other nearby BLM lands in the desert, which will further impact kit fox populations and habitat in those areas.

7. Railway development

The Desert Xpress High-Speed Passenger Train project was approved to construct a 200-mile rail corridor between Victorville, CA and Las Vegas, NV that follows alongside Interstate 15. The construction, operation, and maintenance of rail alignments, passenger stations, maintenance facilities, autotransformers and substations, electrical transmission lines, and temporary construction areas (USFWS 2011) will inevitably disturb desert kit foxes in the area and have long term impacts on the landscape. The impact of this project on desert kit fox habitat connectivity is unknown and was not considered in the Environmental Impact Statement of the project. The Desert Xpress train is another addition to the industrialization suffered by this area of the Mojave Desert.

\(^{17}\) [http://www.fortirwinlandexpansion.com/Background.htm](http://www.fortirwinlandexpansion.com/Background.htm)
8. Anthropogenic climate change

Anthropogenic climate change threatens the long-term survival of the desert kit fox, particularly due to increasing water stress in its desert habitat. The Mojave and Colorado Deserts, which are challenging environments due to their high temperatures and low rainfall, are becoming warmer and drier as a result of climate change. Temperatures and heat wave activity are rising, drought severity and duration are increasing, and streamflow is decreasing during the summer months leading to higher summer water stress, and all of these changes are projected to worsen as greenhouse gas emissions continue to rise.

The desert kit fox is considered an obligate predator (White et al. 1996) that is sensitive to changes in precipitation that have strong influences on the abundance of prey species (White and Garrott 1997, 1999). Kit foxes experience declines in abundance in response to declines in prey species following precipitation shortages (White and Garrott 1997, 1999, Cypher et al. 2000, Dennis and Otten 2000). Thus, increasing water stress due to climate change will impose increased stress on desert kit fox populations. Overall, because ecosystem processes in the Mojave and Colorado Deserts such as vegetation, prey, and disease dynamics are regulated in large part by climatic factors, climate change poses a threat to the survival of the desert kit fox by altering its habitat and prey composition. This section provides an overview of (a) observed impacts of climate change in the Mojave and Colorado Desert ecosystems and (b) projected climate change impacts in these desert ecosystems.

a. Observed impacts of climate change in the Mojave and Colorado Desert ecosystems

Climate change is profoundly affecting the Southwestern United States and the Mojave and Colorado Desert ecosystems inhabited by the desert kit fox. As summarized by Overpeck and Udall (2010): “The climate changes in western North America, particularly the Southwest, have outstripped change elsewhere on the continent, save perhaps in the Arctic” (p. 1642). The U.S. Global Change Research Program’s 2009 report *Climate Change Impacts in the United States* concluded that “[r]ecent warming [in the Southwest] is among the most rapid in the nation, significantly more than the global average in some areas.” In the Southwest, precipitation has decreased during the summer and fall, and temperature increases have made droughts more severe (USGCRP 2009).

California surface temperatures have increased significantly during the past century (Bonfils et al. 2008, Cordero et al. 2011), and the greatest warming in California has occurred in the Mojave and Colorado Deserts, with exceptional warming in recent decades: “the southern part of the state, and the southern deserts in particular, has experienced the greatest amount of warming, and this warming has accelerated over the last 35 years” (Cordero et al. 2011). In the Mojave Desert, the annual average rate of warming between 1970 and 2006 was 0.49 ºC per decade for maximum temperature (Tmax) and 0.39ºC per decade for minimum temperature (Tmin), with the highest warming in spring (March-May). In the Colorado desert, average annual Tmax increased by 0.36ºC per decade and average annual Tmin increased by 0.51 ºC per decade between 1970 and 2006, with the highest rates of warming also in spring (Cordero et al. 2011).

Daytime and nighttime heat wave activity has also increased across California during 1948 to 2006 (Gershunov and Cayan 2008). Warmer nighttime temperatures encourage hotter
daytime temperatures since days begin warmer, and lead to increased heat wave duration and area. Nighttime heat waves increase heat stress to wildlife by eliminating the thermal refuge of cooler temperatures at night:

During a persistent daytime heat wave, cool nights provide respite from the stressful effects of heat on the health and general well-being of plants and animals, as well as for the energy sector, and prepare nature and society to face another day of scorching heat. Heat waves strongly manifested at night eliminate this badly needed opportunity for rejuvenation and increase the chances for catastrophic failure in natural and human systems (Gershunov and Cayan 2008: 3).

Annual precipitation in the Southwestern U.S. decreased over the past century by 1 to 2% per decade, and drought has prevailed in recent years (Trenberth et al. 2007). Precipitation trends vary across California. However, a study of 20th century trends in soil moisture, runoff, and drought characteristics over the contiguous U.S. detected trends toward increased drought duration and severity and lower soil moisture in parts of the west including southern California (Andreadis and Lettenmaier 2006). The timing of streamflow has also shifting earlier in California in recent decades due to earlier springtime snowmelt (Stewart et al. 2004), which leads to more water stress in summer.

b. Projected climate change impacts on the Mojave and Colorado desert regions

In the Mojave and Colorado Desert regions, temperatures will continue to rise, heat extremes and droughts will become more frequent, and streamflow will continue to shift earlier, all of which will place increasing heat and water stress on the desert kit fox and its prey.

Temperatures over California are projected to warm significantly over this century, with more warming in the summer than winter on average (Cayan et al. 2008). Mean annual temperatures are projected to increase by 2.5°C to 4.5°C under the A2 scenario by 2070-2099. On a seasonal basis, summer (June to August) temperatures are projected to increase by 2.6°C to 6.4°C under the A2 scenario, while winter (December to February) temperatures increase by 2.4°C to 3.4°C under the A2 scenario. These projections are especially worrisome given that the worldwide emissions growth rate since 2000 has been largely tracking that of the most-fossil fuel intensive IPCC SRES emissions scenario, A1FI19 (Raupach et al. 2007).

The occurrence of extremely warm days is also projected to increase significantly. Under the A2 scenario, the occurrence of extremely warm daily mean temperatures that exceed the 99.9 percentile of their historical distributions for June to September is projected to increase to 50 to 500 times their historical frequency by 2070–2099, while the incidence of even moderately cool daily mean winter temperatures decreases markedly (Cayan et al. 2008). Cayan et al. (2008) warned that these temperature increases are outside the range of local experience and that temperatures will continue to rise into the twenty-second century:

Such climate changes would be, in the words of Hansen et al. 2007, “climate changes outside of the range of local experience.” A noteworthy feature in the temperature projections is that the warming through the twenty-first Century

does not level off, especially in projections using the medium and high greenhouse gas emission scenarios, implying that California’s climate would continue to warm in (at least) the subsequent decades of the twenty-second century. (Cayan et al. 2008: S40).

Precipitation projections for California are variable. Cayan et al. (2008) projected relatively small (less than ~10%) changes in overall precipitation in California, with no clear projections for increases or decreases in southern California. These researchers noted that analyses using a larger suite of IPCC AR4 climate models under three different emissions scenarios (A1B, A2, B1) yielded larger changes in total precipitation of 5-20%. Cayan et al. (2008) highlighted that a 10–20% change in annual precipitation can be significant, since historically a 15% loss in precipitation placed that year in the lowest third of the annual totals and can profoundly affect runoff. In contrast, Hayhoe et al. (2004) found that mean precipitation in California is projected to decrease in the winter and summer under most emissions scenarios. Similarly, the U.S. Global Change Research Program projected decreases in spring precipitation in California at the end of the century (Figure 8) (USGCRP 2009). A regional synthesis of climate projections found that precipitation is likely to decrease in the Mojave desert region, but future precipitation projections are uncertain for the Colorado desert region (PRBO Conservation Science 2011).

Figure 8. Projected change in spring precipitation across the Southwest, 2080-2099.

Aridity and the frequency of severe drought are projected to increase in the southwestern U.S. including southern California within decades (Seager et al. 2007). Droughts in the Southwest in the historical record have been attributed to persistent La Niña–like conditions in the tropical Pacific Ocean. Although the most severe future droughts are still projected to occur during La Niña events, they are projected to be worse because the La Niña conditions will overlay a more arid base state (Seager et al. 2007). Seager et al. (2007) concluded that “[i]f these models are correct, the levels of aridity of the recent multiyear drought or the Dust Bowl and the 1950s droughts will become the new climatology of the American Southwest within a time frame of years to decades.” As reported by the USGCRP (2009), the projections for an increasing probability of drought in the Southwest are
consistent with observed climate trends including a northward shift in winter and spring storm tracks.

Finally, hydrological conditions are expected to continue to trend towards earlier snowmelt and drier summer conditions (Rauscher et al. 2008). Under an end-of-the-century A2 emissions scenario, increased temperatures forced by greenhouse gas emissions were projected to result in early-season snowmelt-driven runoff as much as two months earlier than present. Rauscher et al. (2008) concluded that reduced snowpack and early runoff are likely to result in substantial modifications to the hydrologic cycle, including reduced river flow and reduced natural snow and soil storage. Similarly, Stewart et al. (2004) found that streamflow would continue to get earlier across the western U.S., including southern California, with many rivers running 30-40 days earlier by the end of the century.

B. Other Factors that Threaten the Desert Kit Fox: Synergistic Threats

1. Disturbed Soil and Invasive Species

The use of off-road vehicles, the development of infrastructure, and military activity result in the destruction of biological soil crusts. Soil crusts are known to be an important conduit for nitrogen in desert ecosystems, and it can take hundreds of years for disturbed crust to recover (Webb et al. 2009). The altered soil fertility caused by these disturbances can alter vegetation composition, resulting in kit fox habitat degradation. Lovich and Bainbridge (1999) compiled a summary of the estimated the natural recovery time in years for California desert plant communities subjected to various anthropogenic impacts (Table 8).

Table 8: Estimated natural recovery times in years for California desert plant communities subjected to various anthropogenic impacts
Source: Lovich and Bainbridge (1999)
Numerous exotic non-native plants have altered plant communities across large areas of the Mojave Desert, outcompeting native species and degrading upland and riparian habitats for native wildlife (Webb et al. 2009). Invasive annual grasses and forbs have displaced native plants, often greatly diminishing the native forage for desert wildlife. These exotic grasses and forbs now dominate plant communities throughout the region. The abundance of exotic forbs and annual grasses (particularly *Schismus barbaratus*, *S. arabicus*, and *Bromus madritenus* ssp. *rubens*) increases the fuel and continuity of fuels, facilitating more-frequent and hotter fires (Ibid). This destroys the less-fire-intolerant native plants and facilitates other exotic plants that thrive in disturbed areas, further transforming the plant communities (Brooks et. al. 2006, Brooks and Pyke 2001).

*Bromus* in particular is increasing the occurrence of episodic desert wildfires. In the aftermath of wildfires, *Bromus* overtakes longer-lived native perennial species, and consequently intensifies the fire cycle (Webb et al. 2009); this could potential alter areas that are historically utilized by desert kit foxes.

Invasive species alter prey composition and habitat ability. Annual kit fox populations are known to closely vary with their primary prey’s abundance (Cypher 2003). San Joaquin kit fox population trends were shown to be driven by prey abundance, particularly that of kangaroo rats (Meaney et al. 2006). A kit fox population studied in Utah showed that their primary prey is not necessarily the most abundant small mammal (Ibid). Therefore it is likely that the desert kit fox’s abundance is tied to the abundance of their primary prey—Merriam’s Kangaroo rats. Given the lack of studies on the desert kit fox, it is impossible to quantify the extent of the threat of a changing ecology driven by invasive plant species. However, this threat of an altered environment is inevitable, and studies on these impacts are sorely lacking.

### 2. Predation and Competition

There are several factors that could cause increased levels of predation on desert kit foxes by coyotes. The spread of exotic grasses that prevents desert kit foxes from eluding coyotes (Meaney et al. 2006), the colonization of kit fox habitat following outbreaks of disease, and the spread of coyotes due to the availability of livestock watering sites and game guzzlers all pose threats to desert kit fox populations.

Coyotes are the primary predators of most North American foxes, including the kit fox. Interference competition is the driving force behind coyote predation on kit foxes; coyotes do not use kit foxes as a food source, but rather kill them and bury their carcasses (Nelson et al. 2007). There is a great amount of prey base overlap between coyotes and kit foxes. Merriam’s Kangaroo rats are the primary prey of desert kit foxes (NPS 2012), and are also important prey for coyotes (Cypher 2003). Periods of low prey abundance causes higher levels of coyote depredation on kit foxes. According to four existing studies on kit foxes in California, 58-75% of mortality for which the cause could be identified are by predation (Meaney et al. 2006). However, the proportion of desert kit fox mortality caused by predators is unknown. Bobcats are also known to prey on kit foxes, but their impact on desert kit foxes in the Mojave is unknown.
VII. Nature, Degree, and Immediacy of Threat

The threats to the desert kit fox from habitat loss and degradation due to large-scale energy development and associated disease risk are immediate, significant, and have accelerated in recent years. With over 114,000 acres of desert kit fox habitat approved for large-scale industrial solar and wind development and close to 1 million acres of desert kit fox habitat currently under environmental review and under application for solar and wind development as of January 2013, it is clear that the desert kit fox faces an immediate and significant threat from habitat loss, degradation, and fragmentation. While Executive Order # S-14-08, signed by Governor Arnold Schwarzenegger raised the renewable energy goal for California to 33% of total energy by 2020 (CEC 2012), this goal is likely to be raised in the near future, putting additional development pressure on desert kit fox habitat.

Moreover, as detailed above, the environmental review processes for large-scale industrial renewable energy projects do not properly consider or mitigate for impacts on the desert kit fox. For example, the Desert Renewable Energy Conservation Plan (DRECP) is a major component of California’s renewable energy planning efforts that seeks to “conserve and manage plant and wildlife communities in the desert regions of California while facilitating the timely permitting of compatible renewable energy projects.” The DRECP planning boundary includes a vast majority of desert kit fox habitat, however, the desert kit fox is not one of the proposed covered species in this management plan since they are not listed as threatened or endangered nor has the desert kit fox been considered a planning species for the DRECP. By failing to consider the desert kit fox as a sensitive species, large-scale industrial renewable energy siting across the California deserts in desert kit fox habitat threatens the long term survival of the species. It is also clear that existing methods of site clearance exacerbate the impacts to kit fox and sufficient avoidance, minimization and mitigation measures have not been developed to successfully eliminate or reduce the threat to the desert kit fox population, while extensive acreage continues to be regularly approved for development.

In addition, the 2011-2012 outbreak of canine distemper at the Genesis Solar site illustrated the fact that large-scale industrial energy development not only excludes desert kit foxes from their habitat, but also poses indirect threats that are not fully understood. It is near impossible to contain potential outbreaks of disease due to a lack of existing monitoring of the health and distribution of desert kit foxes, which underscores the urgency of the threat posed by large-scale industrial energy development.

The use of off-road vehicles and the development of roads in the Mojave Desert are also on the rise, and this activity significantly degrades desert kit fox habitat and causes directly mortality by caved dens and vehicular impacts. With development plans occurring across desert kit fox habitat, it is evident that the population will suffer worsening fragmentation and habitat loss in the immediate future.

Invasive species of vegetation that are introduced and spread by various anthropogenic factors and alter existing ecosystems pose a far-reaching and long-term threat to desert kit foxes that is too complex to mitigate by existing plans. The threat of altered ecosystems and climate change to desert kit foxes must be the subject of scientific studies and be incorporated into regional management plans.
VIII. Impact of Existing Management Efforts

Current management of the desert kit fox is entirely inadequate to monitor and prevent population declines and local or regional extirpations due to the suite of current and emerging threats to this subspecies. Monitoring and research of desert kit fox population status and trends, natural history, and the impacts of anthropogenic threats on the kit fox and its habitat—such as those from large-scale industrial energy development and disease—are lacking, and regulatory mechanisms and conservation programs are inadequate to protect the desert kit fox.

A. State Protection

The desert kit fox is protected as fur-bearing mammal under Title 14 of the California Code of Regulations § 460, which states that kit foxes may not be taken\(^\text{20}\) (Anderson 2012). This amount of protection is clearly inadequate to mitigate the threats desert kit foxes face from large-scale industrial renewable energy development. As previously noted, passive relocation measures failed to exclude desert kit foxes from construction sites even after fences were erected at the Genesis and Ivanpah Solar projects (CEC 2012b). Despite compliance with the minimal requirements regarding relocating kit fox from construction sites, the outbreak of canine distemper demonstrated the inadequacies of current practices with regard to kit fox at large-scale industrial renewable energy sites.

B. Federal Protection

A vast majority of desert kit fox habitat falls within the boundaries of the California Desert Conservation Area, as established by Congress in 1976 by the Federal Lands Management Policy Act. Much of the kit fox’s habitat is public lands managed by the National Park Service, Department of Defense, Bureau of Land Management, and the State, along with some private owners (see Figure 9). There are several land management plans in desert kit fox habitat that involve general conservation efforts (DOI 2010):

- Under the BLM’s California Desert Conservation Area (“CDCA”) Plan (1980) as amended including Northern and Eastern Colorado Desert (NECO), the Northern and Eastern Mojave Desert (NEMO), and the West Mojave Plan (WEMO), the BLM established Areas of Critical Environmental Concern (ACECs) to limit development in critical habitat for primarily for rare and endangered species.

However, none of these plans explicitly address the conservation needs of the desert kit fox. The CDCA Plan, NECO, NEMO, and WEMO in particular are inadequate for the protection of desert kit foxes as they did not consider the current scale of development and in particular the cumulative impacts of large-scale industrial renewable energy projects on habitat fragmentation and disturbance caused to the foxes. NPS General Management Plans also do not afford adequate protection to the desert kit fox as they are not considered in the development of the plans.

\(^{20}\) http://www.fgc.ca.gov/regulations/current/mammalregs.aspx
Under the BLM’s Solar Program, the Solar Energy Zones (SEZs)\textsuperscript{21} and ‘Variance’ land that is open to development includes a vast amount of prime desert kit fox habitat and the exclusions from development afford little protection to desert kit foxes. Given that the Solar Program primarily considered threats to special status species and species currently listed as threatened or endangered, desert kit foxes face indiscriminate development in their habitat that did not take kit fox habitat fragmentation or quality into consideration. The Final Wind Programmatic Environmental Impact Statement\textsuperscript{22} did not consider impacts to the desert kit fox.

**Figure 9: Land Ownership within the Range of the Desert Kit Fox**

\textsuperscript{21} http://solareis.anl.gov/
\textsuperscript{22} http://windes.anl.gov/
IX. Suggestions for Future Management

Desert kit fox management and recovery actions are dependent on gathering information by studying the population. These data needs lie in four areas:

(1) Population status trends of desert kit foxes
(2) Population ecology of desert kit foxes
(3) Individual effects of anthropogenic impacts on desert kit foxes
(4) Population effects of anthropogenic impacts on desert kit foxes

(1) Population status and trends

The relative abundance, average density, and population trends of desert kit foxes are currently unknown. The lack of historic and current knowledge on the status of the subspecies makes it difficult to accurately estimate impacts from changes to their habitat. The relative abundance and density of kit foxes may be determined by several non invasive techniques such as scent-station surveys, den surveys, spotlight surveys, live trapping, remote-sensing, or fecal DNA analysis (Meaney et al. 2006). This knowledge will help in quantifying the impacts on desert kit foxes in habitat susceptible to development, and also to establish conservation goals in prime kit fox habitat.

(2) Population ecology

The occurrence of distinct metapopulations of desert kit foxes is currently unknown. Identification of metapopulations and estimation of immigration between them is essential to the establishment of conservation goals.

(3) Individual effects of anthropogenic impacts

Information on the success of passive relocation efforts during development in desert kit fox habitat is vital in order to sufficiently mitigate impacts on their population. The survival rates of the foxes and distance traveled for the reestablishment of home ranges must be monitored in those animals that are hazed from their dens. This may be accomplished by telemetry and multi-year monitoring of the status of hazed animals. Serological studies on the antibodies present in desert kit foxes prior to hazing, after removal from disturbance sites, and finally, after reestablishing new home ranges would be useful to determine the disease risk caused by development in desert kit fox habitat.

(4) Population effects of anthropogenic impacts

The effects of habitat fragmentation caused by urbanization, large-scale industrial energy development, and associated infrastructure are currently unknown and must be studied in order to determine the cumulative impact of development on the desert kit fox population. Habitat corridors for desert kit foxes must be established in order to prevent siting conflicts with prime areas of fox movement. Secondly, the density, reproduction, and survival of desert kit foxes in and around developed areas must be studied and compared to the same parameters in undisturbed habitat.
With the above information, it would be possible to develop a population viability analysis for desert kit foxes which would predict the probability of the long-term survival in distinct habitat patches or planning areas.

A formal conservation plan for desert kit foxes should include the following features:

- Establishment of a long-term monitoring program to assess the (a) population status and trends of the desert kit fox across the range, (b) magnitude of key anthropogenic threats; (d) population effects of current and emerging threats on the desert kit fox; and (d) success of conservation and impact mitigation efforts.
- Identification and conservation of core populations and prime habitat to maximize desert kit fox conservation and minimize disturbance.
- Consideration of desert kit foxes as an umbrella species to guard flora and fauna in their ecological niche. An umbrella species is defined as a species whose conservation is expected to confer protection to a large number of naturally co-occurring species. The desert kit fox is a wide ranging species in the California desert region, and their habitat requirements include those of many other species, i.e. creosote scrub bush dwelling animals such as the desert tortoise, burrowing owl, Mohave ground squirrel, and others.
- Comprehensive multi-agency cooperation in monitoring and mitigation efforts for desert kit foxes impacted by renewable energy development and other land use impacts.
- Inclusion of desert kit fox monitoring and management into management plans covering desert kit fox habitat (e.g., National Park and BLM management plans).
- Establishment of road signs alerting the public to the presence of desert kit foxes near areas of high fox density.
- Monitoring and study of the effects of development and climate change on the desert kit fox prey base.
- Development and implementation of a plan for long-term serological monitoring and vaccination efforts for disease outbreaks.
X. Availability and Sources of Information


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http://www.nps.gov/jotr/naturescience/kitfox.htm


Palen Solar Power Project. 2010. Staff Assessment and Draft EIS. CEC-700-2010-007.  
http://www.energy.ca.gov/sitingcases/palen/index.html

PdV Wind Energy Project. 2007. DEIR. Chapter 4: Biological Resources.  

http://oak.ucc.nau.edu/pb1/.

http://data.prbo.org/apps/bssc/Climatechange


XI. Detailed Distribution Map
A detailed map of historic and current distribution is provided in Figure 1 (above). There were no records for *Vulpes macrotis arsipur* in the California Natural Diversity Database.