Appendix D: Patch Size & Configuration

Mountain Lion (*Puma concolor*)

Distribution & Status: Mountain lions are widely distributed throughout the western hemisphere (Currier 1983, Chapman and Feldhamer 1982, Maehr 1992, Tesky 1995). The subspecies *F. c. californica* occurs in southern Oregon, California, and Nevada (Hall 1981), between 1,980 and 5,940 ft (590-1,780 m)(CDFG 1990). In 1990, the mountain lion population in California was estimated to be between 2,500-5,000 individuals (CDFG). That same year, Proposition 117 was passed which prohibits hunting and granted puma the status of a California Specially Protected species, though depredation permits are still issued (Torres 2000).

Habitat Associations: The mountain lion is considered a habitat generalist, utilizing brushy stages of a variety of habitat types with good cover (CDFG1990, Spowart and Samson 1986). Within these habitats, mountain lions prefer rocky cliffs, ledges, and vegetated ridgetops that provide cover when hunting (Spowart and Samson 1986, Chapman and Feldhamer 1982), which is primarily mule deer, *Odocoileus hemionus* (Lindzey 1987). Den sites may be located on cliffs, rocky outcrops, caves, in dense thickets or under fallen logs (Chapman and Feldhamer 1982; Ingles 1965). In southern California, most cubs are reared in thick brush (Beier et al. 1995). They prefer vegetated ridgetops and stream courses as travel corridors and hunting routes (Spotwart and Samson 1986, Beier and Barrett 1993).

Spatial Patterns: Home range size varies by sex, age, and the distribution of prey. A recent study in the Sierra Nevada documented annual home range sizes between 250 and 817 km^2 (Pierce et al. 1999). Home ranges in southern California averaged 93 km^2 (SD = 50) for 12 adult female and 363 km^2 (SD = 63) for 2 adult male cougars (Dickson and Beier in press). Male home ranges appear to reflect the density and distribution of females (Maehr 1992). Males occupy distinct areas and are tolerant of transients of both sexes, while the home range of females may overlap completely (CDFG 1990, Beier and Barrett 1993). Regional population counts have not been conducted but in the Santa Ana Mountain Range, Beier (1993) estimated about 1.05-1.2 adults per 100 sq km.

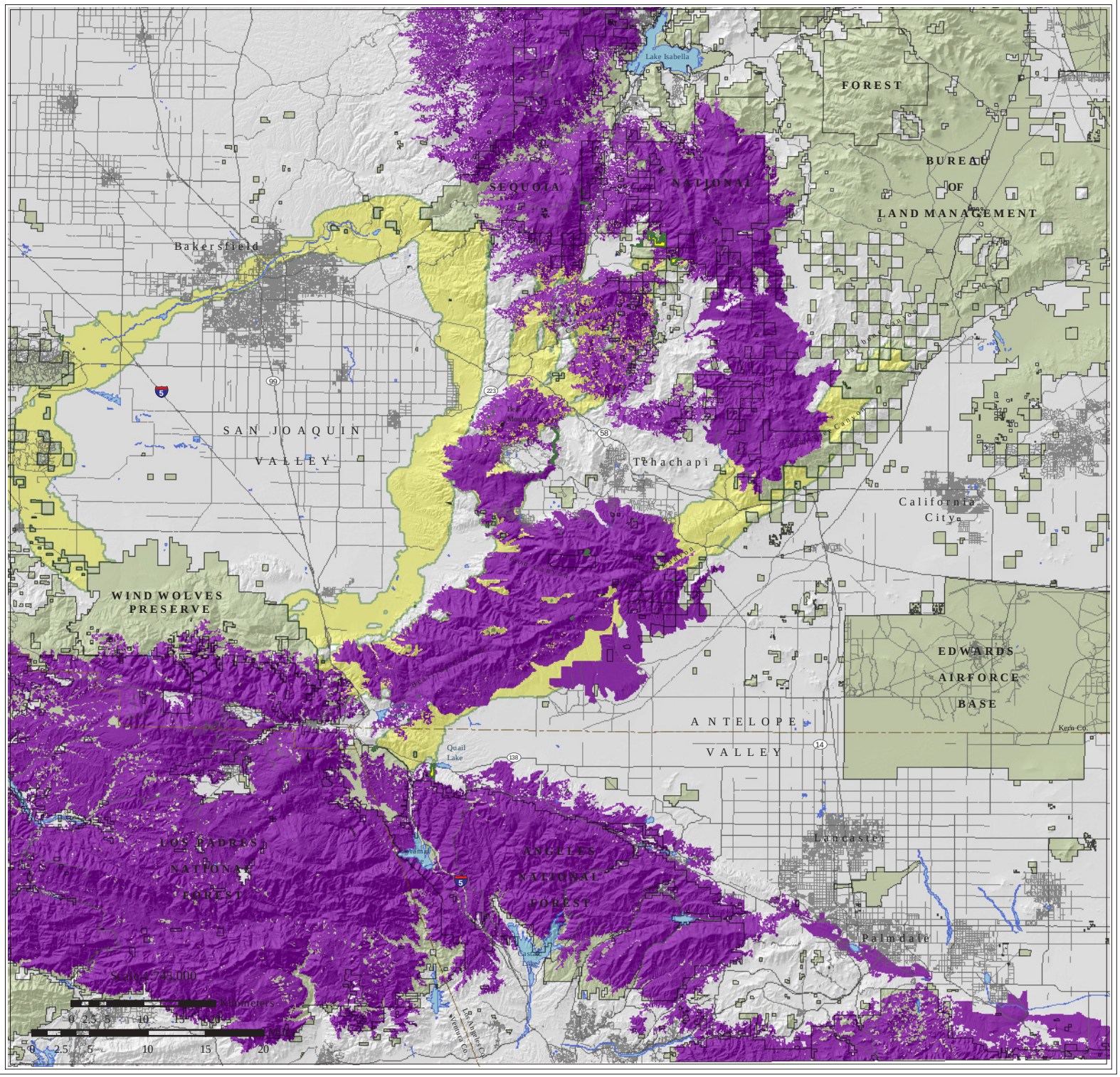
Mountain lions are capable of making long-distance movements, and can have multiple strategies of migration that allow them to take advantage of changing densities of prey (Pierce et al. 1999). In the Santa Ana Mountains, mountain lions moved 6 km per night (Beier et al. 1995) and dispersed up to 65 km (Beier 1995). Dispersal plays a crucial role in cougar population dynamics because recruitment into a local population occurs mainly by immigration of juveniles from adjacent populations, while the populations own offspring emigrate to other areas (Beier 1995, Sweanor et al. 2000). Juvenile dispersal distances average 32 km (range 9-140 km) for females and 85 km (range 23-274 km) for males (Anderson et al. 1992). Dispersing lions may cross large expanses of nonhabitat, though they prefer not to do so (Logan and Sweanor 2001). To allow for dispersal of juveniles and the immigration of transients, lion management should be on a regional basis (Sweanor et al. 2000).

Conceptual Basis for Model Development: Puma will utilize most habitats above 590 m in elevation, provided they have cover. Road density is also a significant factor in habitat suitability for mountain lions. The minimum patch size was defined as 186 km^2, using twice the home range size of 93 km^2. Patch size was classified as $\geq$ 186 km^2 but

< 4,650 km^2. Core areas potentially supporting 50 or more individuals were modeled using patches $\geq$ 4650 km^2 (93 km^2 x 50). Dispersal distance for Puma was defined as 65 km.

Results & Discussion*:* The Least Cost Union is likely to serve this species as sufficient move through habitat was captured in the analysis (Figure 36). The model identified all upland habitat in the Tehachapi Mountains as one contiguous potentially suitable habitat patch ($\geq$ 186 km^2 but < 4,650 km^2), the majority of which was captured in the Least Cost Union. However, no contiguous patches $\geq$ 4,650 km^2 (i.e., core areas capable of potentially supporting 50 individuals) occur within the analysis window, illustrating the importance of maintaining connectivity through the Tehachapis. Extensive habitat exists in the Sierra Madre and Castaic Ranges of the Los Padre and Angeles National Forests, and in the Piute and Greenhorn mountains of the Sequoia National Forest. All habitat patches are well within the dispersal distance of this species. Individual adults may even traverse the entire length of the linkage over a matter of days. This species requires expansive roadless areas to survive and functional connectivity between subpopulations in the existing protected areas.

Figure 36.
Habitat Patches for Mountain lion
(Puma concolor)



Legend

- Least Cost Union
- Patches
- Paved Roads
- Ownership Boundaries
- County Lines

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American Badger (*Taxidea taxus*)

Distribution & Status: Once a fairly widespread resident throughout open habitats of California, badger is now uncommon throughout the state and is considered a California Species of Special Concern (CDFG 1995, CDFG 1999). There have been 2 recent sightings of badger in the linkage planning area, one in the vicinity of Quail Lake and another just south of the California Aqueduct near Maricopa Flat (CDFG 1999).

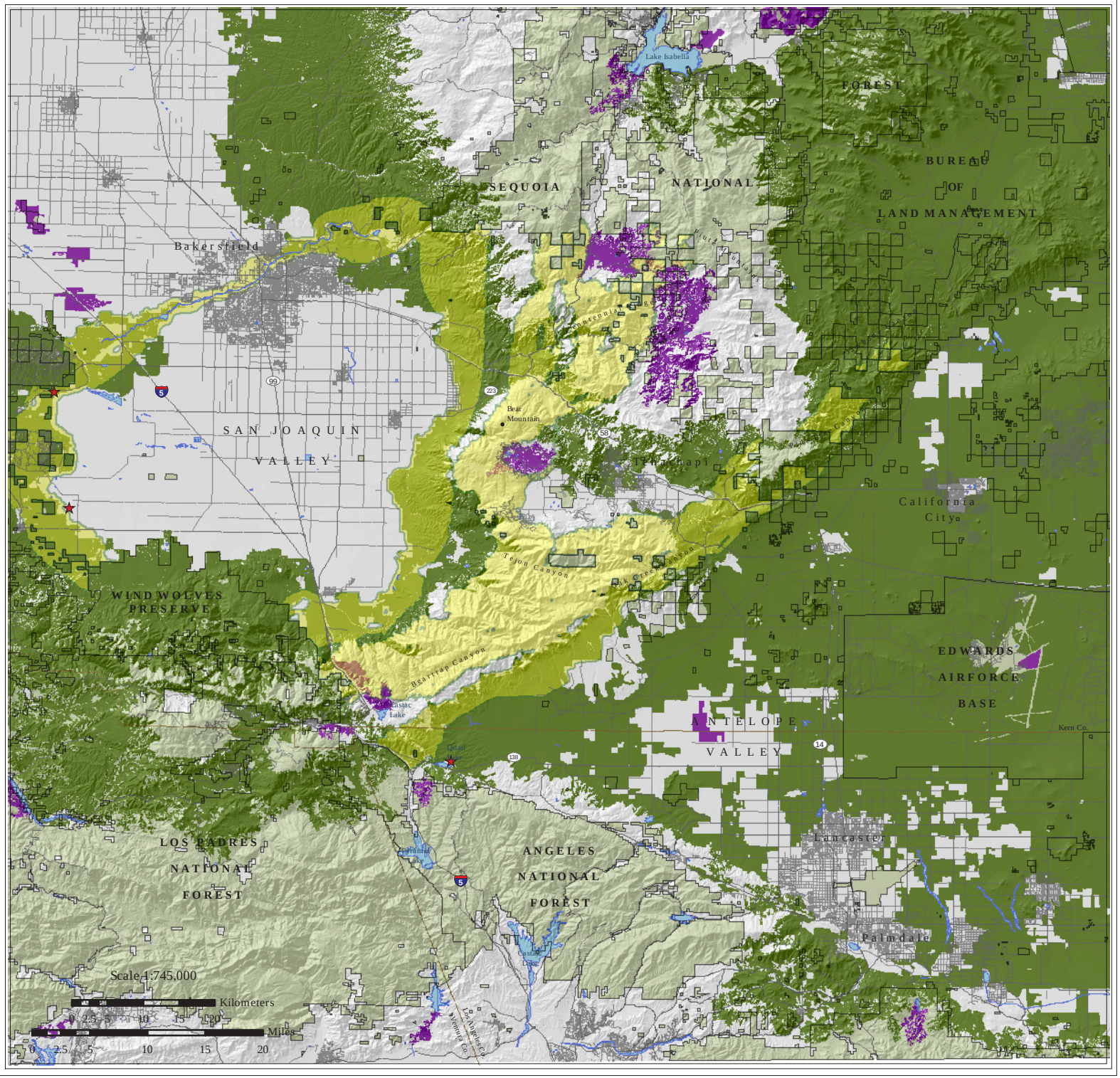
Habitat Associations: Badgers are largely considered habitat specialists, associated with grasslands, prairies, and other open habitats (Banfield 1974; de Vos 1969 *in* Sullivan 1996) but they may also be found in drier open stages of shrub and forest communities (CDFG 1999). They are known to inhabit forest and mountain meadows, marshes, riparian habitats, and desert communities including creosote bush, juniper, and sagebrush habitats (Long and Killingley 1983, CDFG 1999). They are occasionally found in open chaparral (< 50% cover) but haven't been documented in mature stands (Quinn 1990 *in* CDFG 1999). They prefer friable soils for excavating burrows and require abundant rodent populations (Banfield 1974; de Vos 1969 *in* Sullivan 1996). The species is typically found at lower elevations (CDFG 1999) in flat, rolling or steep terrain but it has been recorded at elevations up to 3,600 m (12,000 ft) (Minta 1993).

Spatial Patterns: Home range sizes for this non-migratory species vary both geographically and seasonally. Male home ranges have been estimated between 240-850 ha and females at 137-725 ha (Long 1973, Lindzey 1978, Messick and Hornocker 1981, CDFG 1999). Though, in northwestern Wyoming, home ranges up to 2100 ha have been reported (Minta 1993). In Idaho, home ranges of adult females and males averaged 160 ha and 240 ha respectively (Messick and Hornocker 1981). Badgers may exhibit seasonal changes in home range size, being more restricted in winter (CDFG 1999). In Minnesota, Sargeant and Warner (1972) radio-collared a female badger, whose overall home range encompassed 850 ha; range was restricted to 725 ha in summer, 53 ha in autumn, and to a mere 2 ha area in winter. In Utah, Lindsey (1978) found fall and winter home ranges of females varied from 137-304 ha, while males varied from 537-627 ha (Lindzey 1978). Males may double movement rates and expand their home ranges during the breeding season to maximize encounters with females (Minta 1993). Lindzey (1978) documented natal dispersal distance for one male (110 km) and one female (51 km).

Conceptual Basis for Model Development: Prefers grasslands, meadows, scrubs, riparian, desert washes and open woodland communities. Terrain may be flat, rolling or steep but below 3,600 m (12,000 ft) in elevation. The minimum patch size was defined as 2 home ranges (480 ha), using the smallest recorded range (240 ha x 2). Core Areas containing fifty badgers are equal to or greater than 12,000 ha in size (240 ha x 50). Patch size is $\geq$ 480 ha but < 12,000 ha. Maximum dispersal distance for male badgers is 110 km, while the longest recorded distance for females is 51 km; both distances were evaluated.

Results & Discussion: The linkage will likely serve this species since sufficient live in and move through habitat was captured in the Least Cost Union (Figure 37). The model identified extensive core areas in the grassland and foothill habitat that exists in a contiguous belt along the fringe of the southern San Joaquin Valley, from Wind Wolves

Figure 37.
Potential Cores & Patches for American badger
(Taxidea taxus)



Legend

- Least Cost Union
- Potential Cores
- Patches
- CNDDB Observation
- Paved Roads
- Ownership Boundaries
- County Lines

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Preserve and Los Padres National Forest, along the base of the Tehachapi Mountains, to the southwestern portion of Sequoia National Forest. The Least Cost Union also encompasses a fairly contiguous block of potential core habitat for this species in the grassland, desert scrub and woodland communities of the Antelope Valley, from protected core areas in the Sierra Madre, San Emigdio, and Castaic Ranges, along the southeastern slopes of the Tehachapi Mountains, to the Jawbone Canyon area managed by the Bureau of Land Management. Extensive core habitat areas also exist outside of the Least Cost Union, near Wheeler Ridge, in Tejon Canyon, around Quail Lake, in the Tehachapi Valley, in the foothills of the Sierras north and south of the Kern River, and in desert scrub habitats of the Antelope Valley. All potentially suitable habitat patches captured within the Least Cost Union that will support at least two individuals are within the 51 km dispersal distance of this species.

San Joaquin kit fox (*Vulpes macrotis mutica*)

Distribution & Status: Historically, the San Joaquin kit fox was widely distributed on the valley floor and adjacent low foothills of the San Joaquin Valley, from the vicinity of Byron in Contra Costa County, extending southward to the foothills of the Tehachapi Mountains. By 1930, its range had already been reduced by half, with the largest remaining populations in the southern and western portions of the valley (USFS 2002). The species was federally listed as endangered in 1967 and state-listed as threatened in 1971 (USFWS 1998). No comprehensive surveys have been conducted of the entire historical range, but experts believe the fox inhabits remaining suitable habitat on the San Joaquin Valley floor and in the surrounding foothills and valleys of the coastal ranges, Sierra Nevada and Tehachapi Mountains (Thelander 1994; USFWS 1998).

Habitat Associations: Topography and vegetative cover strongly influence the distribution of kit fox, but prey availability and predator avoidance also have an effect on habitat use by this species (Grinnell et al. 1937, Egoscue 1962, Daneke et al. 1984, Zoellick et al. 1989 *in* Warrick and Cypher 1998). This small mammalian carnivore primarily inhabits native or annual grasslands and sparsely vegetated scrub habitats with abundant rodent populations, such as alkali sink scrub, saltbush scrub, and chenopod scrub, though oak woodlands, vernal pools, alkali meadows and playas also provide habitat (USFWS 1998, Brown et al. undated material). They prefer open environments so they can more easily detect predators (Warrick and Cypher 1998). Research has also shown high capture rates in recently burned areas, which was attributed to the openness of the habitat and its affect on predator evasion (Zoellick et al. 1989 *in* Warrick and Cypher 1998). The species can also persist in and adjacent to some kinds of agriculture (row crops, irrigated pastures, orchards, vineyards) and urban areas (USFWS 1998); though these are indisputably sub optimal environments to maintain native wildlife or recover populations of endangered species (Cypher and Frost 1999).

Spatial Patterns: The species is typically associated with lower elevations, though it has been recorded just east of Fort Tejon at 363 m (1,200 ft) (Grinnell et al. 1937, USFWS 1983 *in* USFWS 1998) and up to 473 m (1319 ft) (B. Cypher pers. comm.). They are mainly associated with gently sloping and flat terrain. The literature suggests slopes of 0-5% are ideal, slopes of 5-10% provide fair habitat, and places with slopes >10% are largely unsuitable for kit fox (Haight et al. 2002). Warrick and Cypher (1998) found the spatial distribution of kit fox in the Elk and Buena Vista hills of the Temblor Range to be consistently affected by topography (Warrick and Cypher 1998, Zoellick et al. 2002).

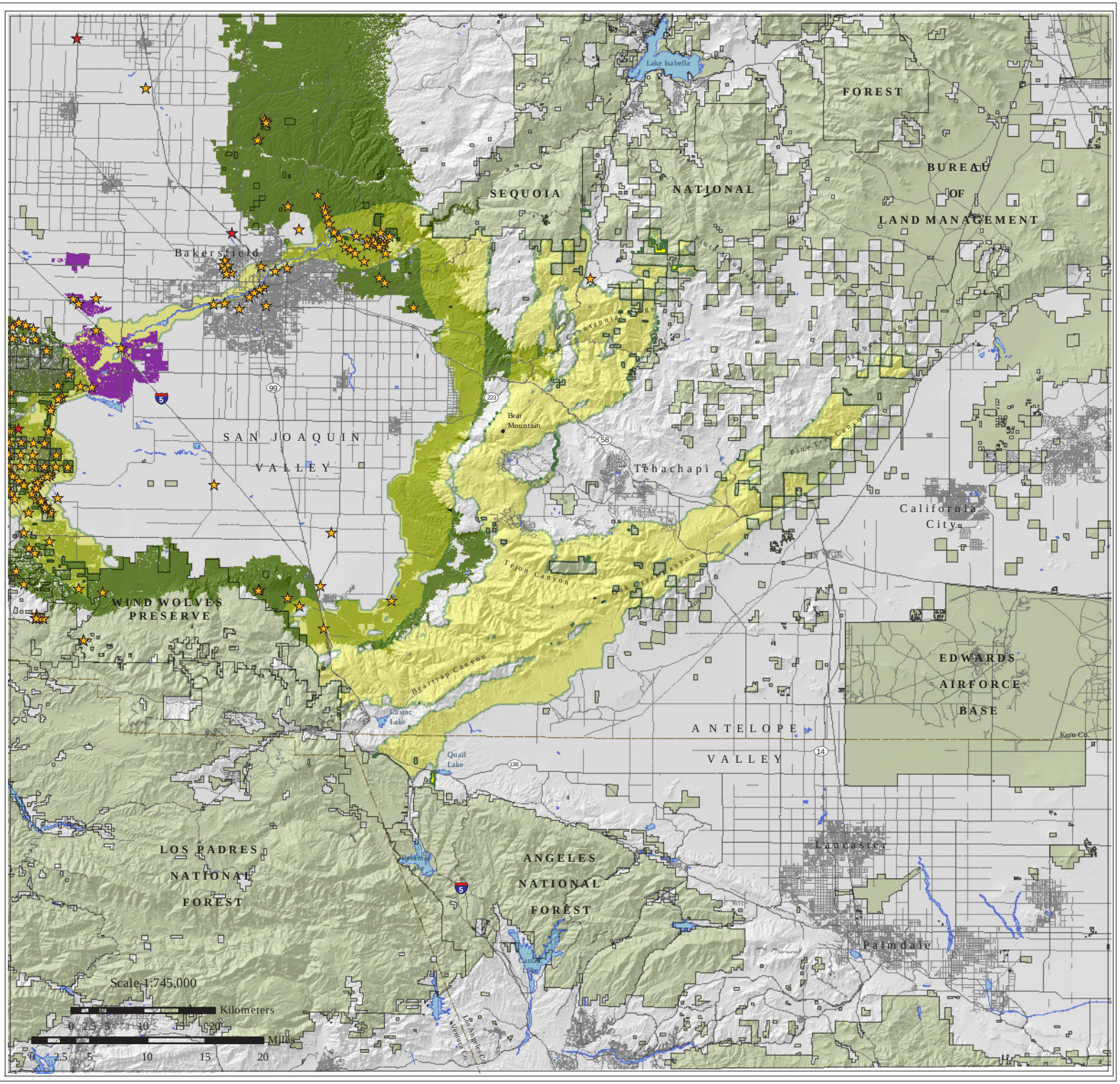
Home range estimates vary from less than 1 mi^2 (2.59 km^2) up to approximately 12 mi^2 (31.08 km^2)(Morrell 1972, Knapp 1978, Zoellick et al. 1987, Spiegel and Bradbury 1992, White and Ralls 1993 *in* USFS 2002). Home range size is largely dependent on prey availability, which can vary annually (Haight et al. 2002). In 2000, home range sizes at the Naval Petroleum Reserve averaged 5.2 km^2 (Koopman et al.), while in 2002 the mean was 4.6 km^2 (Zoellick et al. 2002). In the Carrizo Plain, home range size averaged 11.6 km^2 (White and Ralls 1993 in Zoellick et al. 2002). Haight et al (2002) assumed 2 kit foxes per home range, which they estimated averaged 3.9 km^2 in good habitat and 7.8 km^2 in fair habitat (Haight et al. 2002). Studies indicate that a density of one kit fox per square mile is a reasonable figure to use to estimate populations based on known acreage of habitat (CDFG 2000).

Juvenile dispersal can be less than 5 miles or up to 60 miles from their natal dens (Thelander 1994). Koopman et al. (2000) found that 33% dispersed from their natal territory, significantly more males (49%) than females (24%). Dispersal distances vary widely, with male foxes known to travel over 40 km (Haight et al. 2002). Average length of nightly movements during the breeding period (14.6 $\pm$ 1.1 km) was greater than during pup-rearing (10.7 $\pm$ 1.0 km), and pup dispersal periods (9.4 $\pm$ 1.1 km) (Zoellick et al. 2002). Mean dispersal distance of kit foxes at the Naval Petroleum Reserves was 7.8 $\pm$ 1.1 km (n=48) and didn't differ between sexes (Scrivner et al. 1987 *in* Koopman et al. 2000).

Conceptual Basis for Model Development: This species prefers grasslands and sparsely vegetated scrub habitats in the San Joaquin Valley and surrounding foothills below 473 m in elevation. The minimum patch size was defined as 2 home ranges (517.8 ha), using the smallest recorded range (258.9 ha x 2). Patch size was classified as $\geq$ 517.8 ha but < 12,945 ha. Core areas potentially supporting 50 or more kit fox are $\geq$ 12,945 ha (258.9 ha x 50). Dispersal distance was defined as 60 miles.

Results & Discussion: The linkage will likely serve this species, since both sufficient live in and move through habitat has been incorporated into the conservation design (Figure 38). The model identified the fairly contiguous band of remnant grassland habitat along the perimeter of the southern San Joaquin Valley as core habitat for this species. All core areas and patches are well within the species maximum dispersal distance of 60 miles. Other important habitat identified outside of the Least Cost Union exists on Wheeler Ridge, in the Tejon Canyon area, in the Elk Hills, and around Bakersfield south of the Kern River. This species will also benefit from the habitat added to the Least Cost Union.

Figure 38.
Potential Cores & Patches for San Joaquin kit fox
(Vulpes macrotis mutica)



Legend

- Least Cost Union
- Potential Cores
- Patches
- SERP Occurences*
- CNDDB Observation
- Paved Roads
- Ownership Boundaries
- County Lines

*Data courtesy of CSUS Endangered Species Recovery Program, 1998.

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Mule Deer (*Odocoileus hemionus*)

Distribution & Status: Mule deer have a widespread distribution in California and are common to abundant in appropriate habitat; they are absent from areas with no cover, such as desert communities or agricultural areas (Longhurst et al. 1952, Ingles 1965 *in* CDFG 1990). Mule deer are classified by the California Department of Fish & Game as a big game animal.

Habitat Associations: This species requires a mosaic of habitat types of different age classes to meet its life history requirements (CDFG 1983). They utilize forest, woodland, brush, and meadow habitats, reaching their highest densities in oak woodlands, riparian areas, and along edges of meadows and grasslands (Bowyer 1986 *in* USFS 2002). Access to a perennial water source is critical in summer. They also occur in open scrub, young chaparral and low elevation coniferous forests (Bowyer 1986 *in* USFS 2002). A variety of brush cover and tree thickets interspersed with meadows and shrubby areas are important for food and cover. Thick cover can provide escape from predators, shade in the summer, or shelter from wind, rain and snow. Varying slopes and topographic relief are important for providing shade or exposure to the sun. Fawning occurs in moderately dense chaparral, forests, riparian areas and meadow edges (CDFG 1983); meadows are particularly important as fawning habitat (Bowyer 1986 *in* USFS 2002).

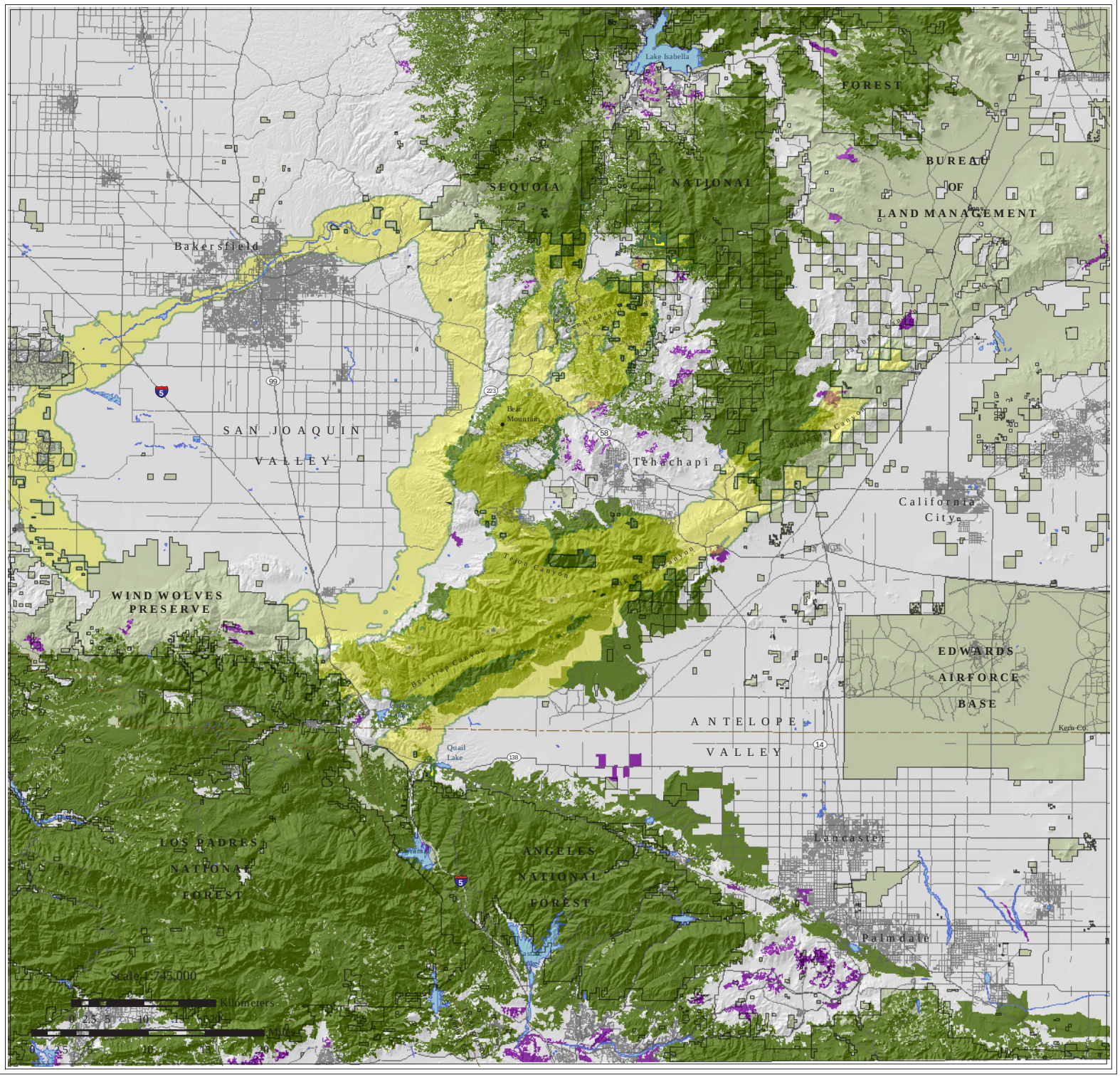
Spatial Patterns: Home ranges typically comprise a mosaic of habitat types that provide deer with various life history requirements. Several home range estimates exist in the literature, ranging from 39 ha (Miller 1970) to 3,379 ha (Severson and Carter 1978 *in* Anderson and Wallmo 1984, Nicholson et al. 1997). Harestad and Bunnell (1979) calculated mean home range from several studies as 285.3 (*in* Anderson and Wallmo 1984). Doe and fawn groups have smaller home ranges averaging 100-300 ha, but can vary from 50 to 500 ha (Taberman and Dasmann 1958 *in* CDFG 1983). Bucks usually have larger home ranges and are known to wander further distances (Brown 1961 *in* CDFG 1990). A recent study of 5 different sites throughout California, recorded home range sizes between 49-1138 ha (Kie et al. 2002).

Where seasonally nomadic, winter and summer home ranges tend to largely overlap in consecutive years (Anderson and Wallmo 1984). Elevational migrations are observed in mountainous regions in response to extreme weather events in winter, or to seek shade and a perennial water source during the summer (Loft et al. 1998 *in* USFS 2002, CDFG 1983, Nicholson et al.1997). Distances traveled between winter and summer ranges vary from 8.6 to 29.8 km (Gruell and Papez 1963, Bertram and Rempel 1977 *in* Anderson and Wallmo 1984, Nicholson et al. 1997). Robinette (1966) observed natal dispersal distances ranging from 97 to 217 km (*in* Anderson and Wallmo 1984).

Conceptual Basis for Model Development: They utilize grassland, and meadow habitats, reaching their highest densities in oak woodland. Requires access to perennial water. The minimum patch size was defined as 2 home ranges (78ha), using the smallest recorded range (39 ha x 2). Patch size was classified as $\geq$ 78 ha but < 1950 ha. Core areas potentially supporting 50 or more deer are equal to and greater than 1950 ha (78 ha x50). Dispersal distance was defined as 97 km.

Results & Discussion: The Least Cost Union will also likely serve the needs of Mule deer living in or moving through the linkage (Figure 39). A fairly contiguous block of potentially suitable core habitat occurs throughout the hardwood and coniferous forest belt of the Tehachapi Mountains, from Castac Lake to Bear Mountain. Other core areas included in the Least Cost Union include Centennial Ridge and Sugarloaf Mountain. All core areas and patches (min size to core size) are within the dispersal distance of this species.

Figure 39.
Potential Cores & Patches for Mule deer
(Odocoileus hemionus)



Legend

- Least Cost Union
- Potential Cores
- Patches
- Paved Roads
- Ownership Boundaries
- County Lines

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Western Gray Squirrel (*Sciurus griseus*)

Distribution & Status: Western gray squirrels are found in Washington, Oregon, California, and Nevada (Ryan and Carey 1995). In California they occur in the Klamath, Cascade, Sierra Nevada, Coast, Tehachapi, Little San Bernardino, Santa Rosa, and Laguna mountains (Ingles 1995 *in* CDFG 1990, USFWS 2002). The species is designated as a federal species of concern.

Habitat Association: Prefers mature stands of moist conifer, hardwood, and mixed hardwood-conifer habitats (Ingles 1995 *in* CDFG 1990). Closely associated with oak species abundance and diversity, they rely mostly on acorns, though pinecones, and other nuts, some fungi, berries and insects are also consumed. They are classic scatter hoarders with caches buried throughout their home range, using olfaction and memory to retrieve their stashes (Halloran 1999). These cavity nesters require diverse oak woodlands and stands of mixed conifer with heritage oaks and snags for cover, foraging and nesting habitat (CDFG 1990)

Spatial Patterns: The distribution of squirrels in the landscape is dependent on the size of the oak stand and adjacency to other forests and to water. Patch size must be diverse enough to provide adequate resources throughout the year and large enough for occupancy of multiple individuals, providing a greater chance of persistence (Ryan and Carey 1995); home range size is negatively associated with food resources and population density (Halloran 1999). Western gray squirrels aren't territorial, exhibiting small overlapping home ranges; typically 3 hectares in size, but can vary from 0.5 hectares to greater than 7 hectares (Halloran 1999). In Washington, it was found to prefer stands > 8 ha and < 0.6 km from water, with an average summer range between 2.6 and 4.2 ha, but this study was based on a total of 38 squirrel observations in 30 of 169 forest stands at Ft. Lewis, WA, where the species has been proposed for federal listing as endangered (Gilman 1986, Asserson 1974, Foster 1992, *in* Ryan and Carey 1995). Adjacency of oak stands to other forested habitats provides additional food and may provide connections to other patches of core oak woodlands and forested habitats (Ryan and Carey 1995). No dispersal or movement distances were mentioned in the literature for this species

Conceptual Basis for Model Development: This species occurs in moist conifer, hardwood, and mixed hardwood-conifer habitats (Ingles 1995), typically between 1,600 and 7,000 ft (Vaughan 1954 *in* CDFG 1990). The minimum patch size was defined as 2 home ranges 1 ha, using the smallest recorded range (0.5 ha x 2). Core areas potentially supporting 50 or more Western gray squirrel are $\geq$ to 25 ha (0.5 ha x 50). Patch size is defined as $\geq$ 1 ha but < 25 ha. No dispersal or movement distances were cited in the available literature.

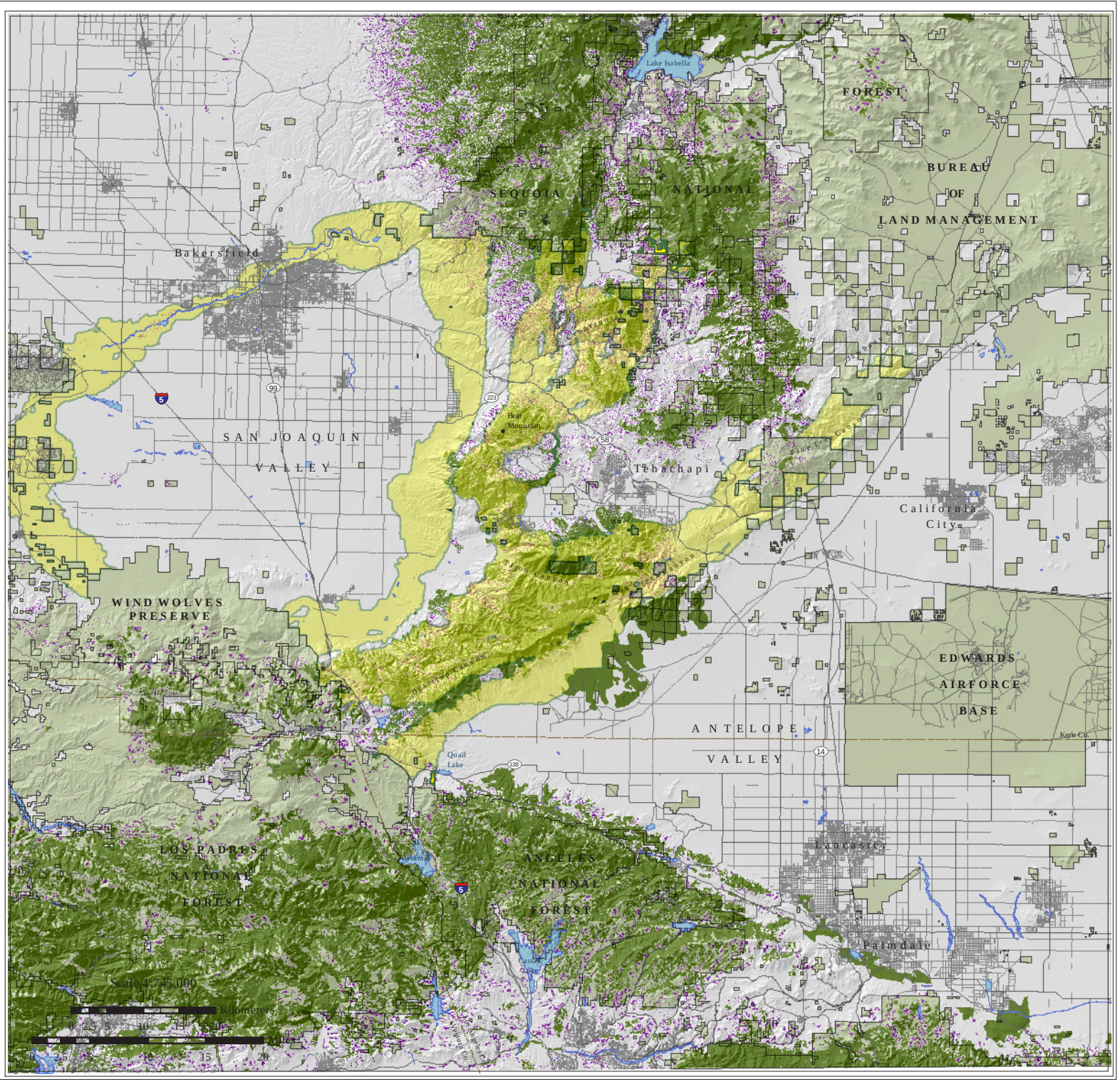
Results & Discussion: The Least Cost Union analysis encompasses the majority of areas identified as important for the Western gray squirrel to live in or make intergenerational movements between core areas (Figure 40). Potentially suitable core habitat for this species is distributed almost continuously from the Castaic and Sierra Madre Ranges, through the montane hardwood and coniferous forests of the Tehachapi Mountains to the Sierra Nevada.

Figure 40.
Potential Cores & Patches
for
Western gray squirrel

(Sciurus griseus)

Legend

- Least Cost Union
- Potential Cores
- Patches
- Paved Roads
- Ownership Boundaries
- County Lines



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Tehachapi Pocket Mouse (*Perognathus alticola inexpectatus*)

Distribution & Status: This endemic species ranges from as far west as Cuddy Valley near Mount Pinos, east along the southeastern flank of the Tehachapis to Sand Canyon, and southeast along the northern slope of the San Gabriels to Elizabeth Lake (Williams et al. 1993). The first specimen was collected west of Lebec at an elevation of 6,000 ft; it has since been recorded as low as 3,500 ft (CDFG 1986). It has been documented from Gorman, Mt. Pinos, Lebec, Cuddy Valley, and the Tehachapi Pass area, from Tehachapi Peak, Oak Creek Canyon, Cameron Canyon, and Sand Canyon, and around Elizabeth Lake, Quail Lake, and Lake Hughes (Williams 1978 *in* CDFG 1986, Laabs 1989, Sulentich 1983). Habitat for this species appears to be nearly continuous along the desert slopes of the southern Sierra Nevada, Tehachapi Mountains, and San Gabriel Mountains (CDFG 1986, Stephenson and Calcarone 1999). The majority of suitable habitat for this species occurs on private land, most notably Tejon Ranch, which hasn't been extensively sampled.

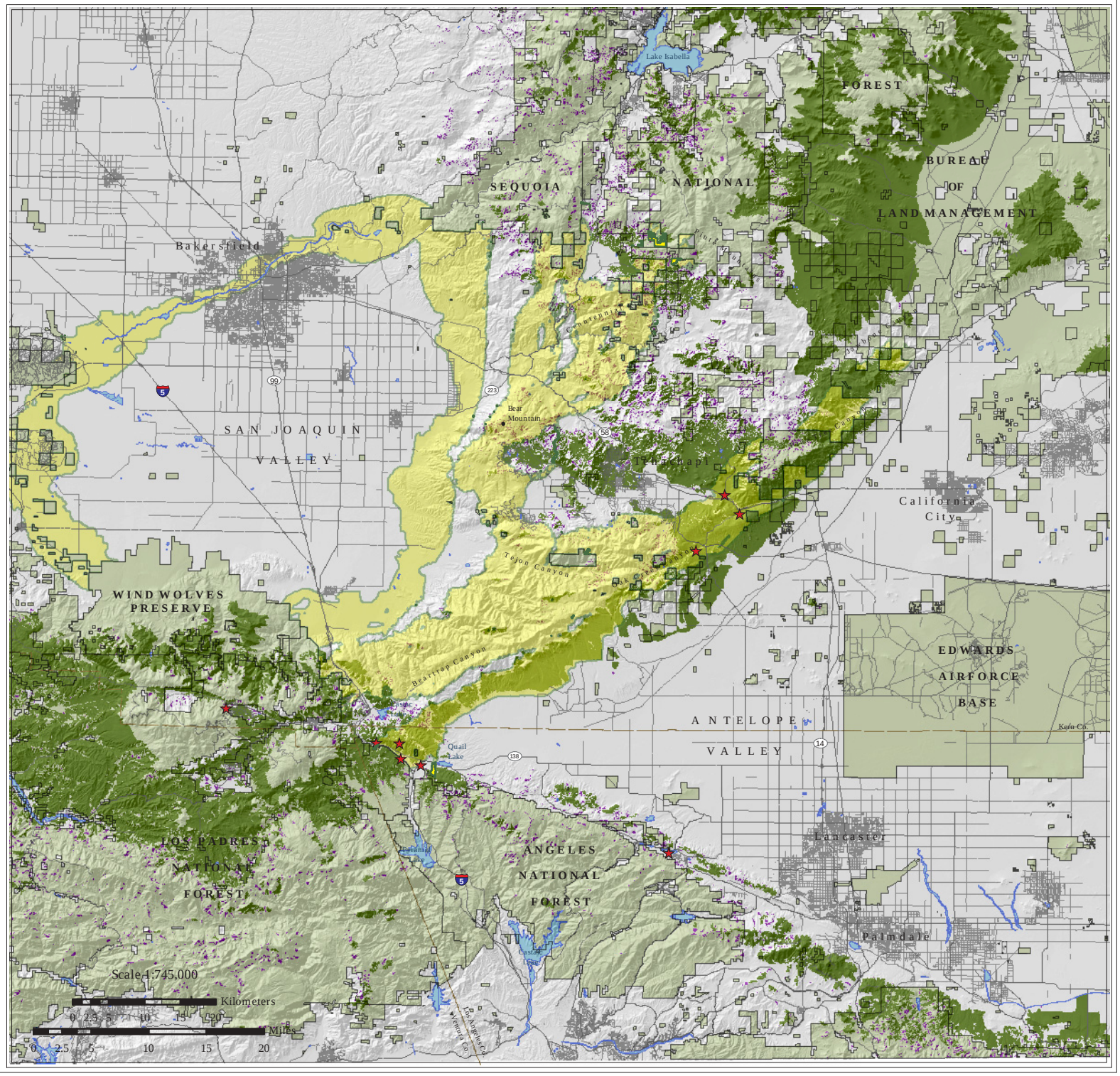
Habitat Associations: This species is known to utilize coastal sage, chaparral, desert scrub, pinyon-pine woodland, Joshua tree woodland, arid grasslands, grassy flats among scattered Jeffrey or Ponderosa pine, and oak savanna habitats (Williams et al. 1993, Best 1994 *in* Labbs, undated mat.); it has also been recorded in fallow grain fields (CDFG 1986). It is primarily associated with fine sandy soils on flats or in gently sloping terrain; steep slopes may act as barriers (W. Spencer, pers. com.).

Spatial Patterns: Because of the rarity of this species, and the fact that the majority of its range is on private land, the spatial requirements of this species are largely unknown. Movements are thought to be very limited; dispersal may be about 100 meters or so (W. Spencer, pers. comm.).

Conceptual Basis for Model Development: This species inhabits desert scrub, Joshua tree woodland, pinyon-juniper, perennial and annual grasslands, desert wash and open coniferous forests between 3500 to 6000 feet. Presently no home range or dispersal distance data exists on Tehachapi pocket mouse, so values were used for Little Pocket Mouse (*P. longimembris*), a similar sized congener. Female home range varies from 0.48 to 3.09 ha (Maza et al. 1973). The minimum patch size was defined as 1 ha, since that is the minimum mapping unit. Patch size was defined as $\geq$ 1 ha but < 24 ha. Core Areas potentially containing fifty individuals were defined as $\geq$ 24 ha in size (0.48 ha x 50). Maximum dispersal distance was defined as 100 m.

Results & Discussion: It appears that the modeled linkage would adequately serve the species, with sufficient live-in habitat to support interconnected populations along the desert-facing slopes of the Tehachapis (Figure 41). The patch size and configuration analyses identified these extensive core areas to be within the dispersal distance of the species (Figure 42). However, uncertainties remain due to the lack of sufficient survey data within the species' range, and concerns about habitat type-conversion of desert communities to nonnative grasslands, as exacerbated by frequent fire. Climate change could also result in upslope migration of suitable habitats, potentially fragmenting this apparently continuous distribution. Although this portion of the study area is relatively free of roads, the degree to which roads, canals, or other features may limit movements along the linkage are unknown.

Figure 41.
Potential Cores & Patches
for
Tehachapi pocket mouse
(Perognathus alticola inexpectatus)



Legend

- Least Cost Union
- Potential Cores
- Patches
- CNDDB Observation
- Paved Roads
- Ownership Boundaries
- County Lines

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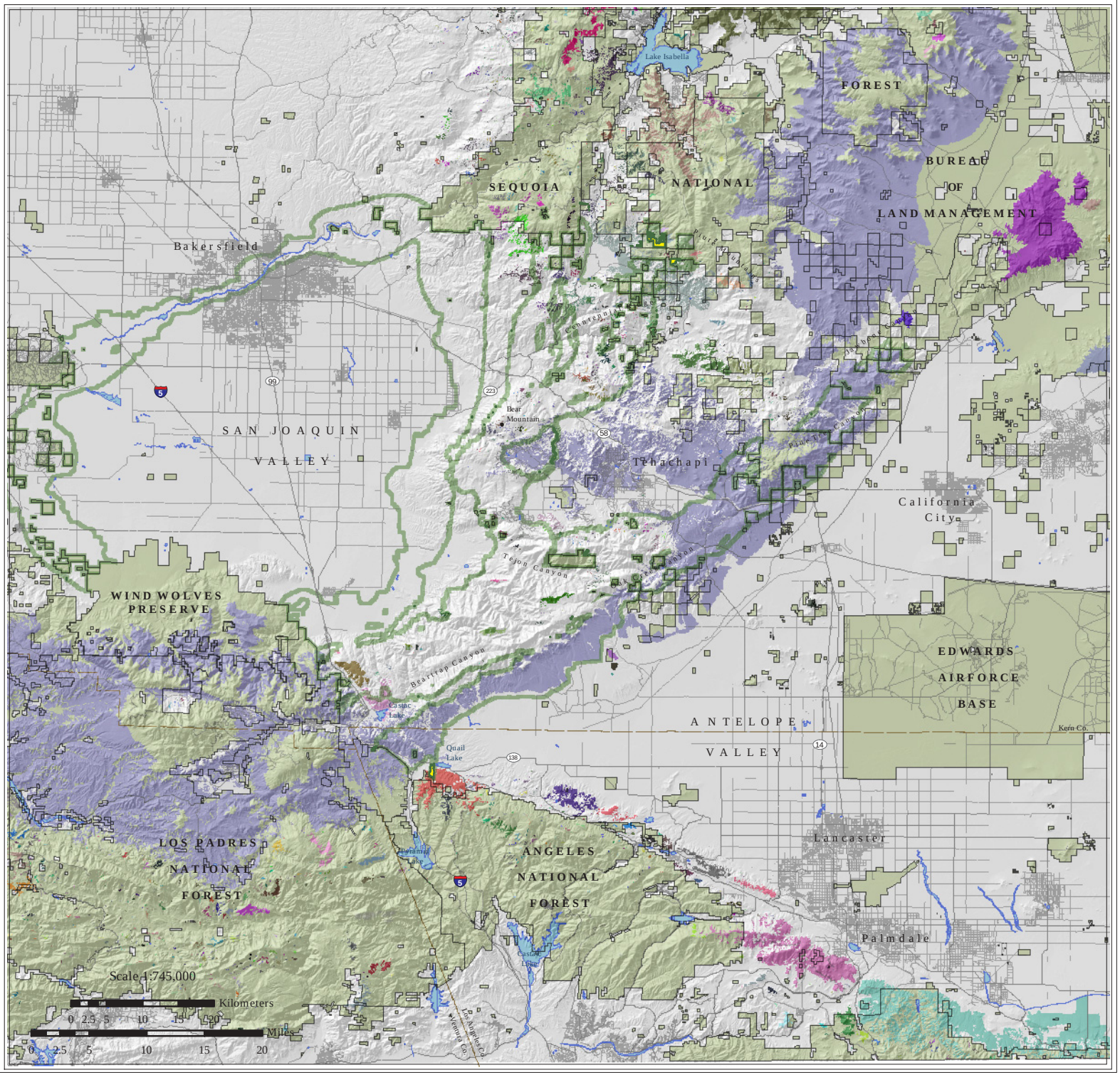
Figure 42.
Patch Configuration
for
Tehachapi pocket mouse
(Perognathus alticola inexpectatus)

Legend

- Paved Roads
- Ownership Boundaries
- County Lines
- Least Cost Union

Colors signify patches of suitable habitat that are within a dispersal distance of 120 m.



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California Spotted Owl (*Strix occidentalis occidentalis*)

Distribution & Status: The California spotted owl is one of three subspecies that inhabits the Sierra Nevada and southern California coastal, Transverse, and Peninsular ranges (Remsen 1978, LaHaye et al. 1997). The first specimen was collected in 1859 in the Tehachapi Mountains (Gutierrez et al. 1992). The elevational range of the owl extends from lower than 1,000 feet to as high as 8,500 feet. It is a California Species of Special Concern and was recently proposed for listing under the federal Endangered Species Act.

Habitat Associations: This species is associated with structurally complex mature or old growth hardwood, riparian-hardwood, hardwood-conifer, mixed and pure conifer habitats with substantial canopy cover (>70%) and majestic long-standing trees and snags (Verner et al. 1992, Gutiérrez et al. 1992, LaHaye et al. 1994, Moen and Gutiérrez 1997). Nest trees are typically the largest in the stand (Gutiérrez et al. 1992), which usually contains an accumulation of down woody debris with a well-developed soil layer (Verner et al. 1992). Foraging habitat for this subspecies can be more variable than its northern relative, sometimes hunting in relatively open terrain (Gutierrez et al. 1992).

Spatial Patterns: This subspecies incorporates large tracts of mature and old growth forests into its home range (LaHaye et al. 1997), requiring extensive blocks [40-240 ha (100-600 ac)] that contain suitable nesting and roosting habitat, as well as available water (Forsman1976 *in* CDFG 1990). In the mature Douglas-fir/hemlock forests of Oregon, Forsman et al. (1977) found home range to vary between 120-240 ha (300-600 ac), and similar home range sizes have been recorded in the Sierra Nevada (Gould 1974 *in* CDFG 1990). The distribution of prey has been found to strongly influence the size of an owl's home range (Carey et al. 1992, Zabel et al. 1995 *in* Smith et al. 1999), and habitat use patterns (Carey et al. 1992, Carey and Peeler 1995, Zabel et al. 1995, Ward et al. 1998 *in* Smith et al. 1999). Lower elevation habitats may be more productive due to higher prey densities in surrounding vegetative communities. Occupied habitat at lower elevations is typically dense, mature forest on north-facing slopes and deep canyons (Stephenson and Calcarone 1999).

Home ranges are generally spaced 1.6 to 3.2 km (1-2 mi) apart in appropriate habitat (Marshall 1942, Gould 1974 *in* CDFG 1990). Owl densities are greater in areas with a higher density of old trees in dense groves (Gutierrez et al. 1992). Smith (1995) estimated owl density for the San Bernardino population to be 0.43 per km^2 for oak/big-cone fir, 0.20 per km^2 for conifer/hardwood, and 0.11 owls per km^2 for mixed coniferous forests (*in* LaHaye et al. 1997). Owl densities in Sequoia Kings Canyon National Parks have been recorded at 12.8 pairs per 100 km^2, while densities of 10.0 pairs per 100 km^2 have been estimated for the Sierra National Forest (North et al. 2000). LaHaye et al. (1997) suggested higher densities might reflect smaller territory sizes, which could result from increased prey densities.

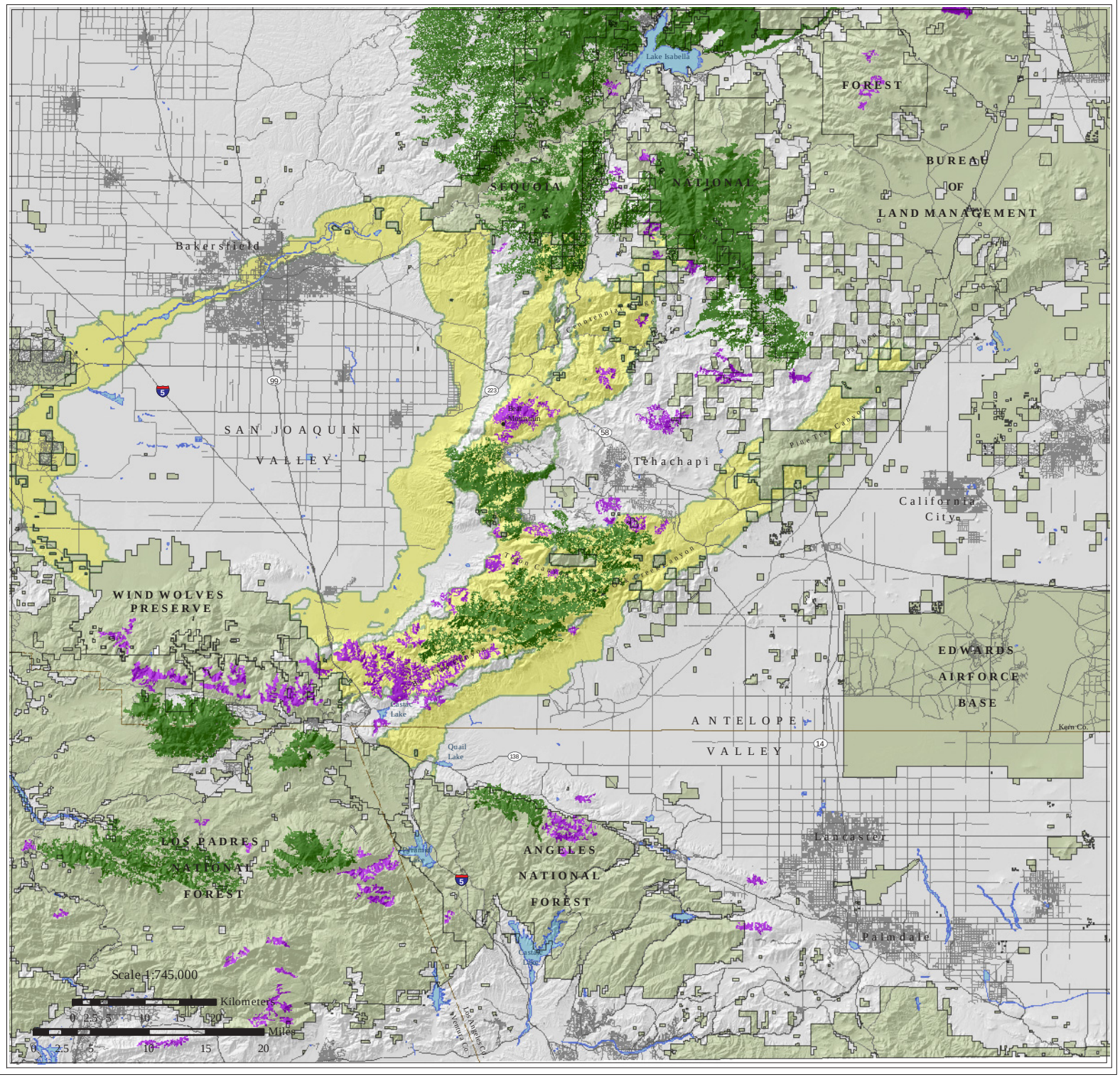
Metapopulation analyses have estimated dispersal distances of 7-60 km (LaHaye et al. 1994). However, shorter dispersal distances have been recorded. In the San Bernardino Mountain population, 67 males and 62 females dispersed 2.3-36.4 km and 0.4 –35.7 respectively (LaHaye et al. 2001). Dispersal distances for spotted owls in other populations range from 5.8 (Ganey et al. 1998) to 56 km (Gutierrez et al. 1996).

Several radio telemetry studies have been conducted (Miller et al. 1997, Ganey et al. 1998, Willey and van Riper 2000) that recorded even greater distances, up to 72.1 km (in LaHaye et al. 2001).

Conceptual Basis for Model Development: This species prefers mature and old growth forests below 8,500 feet in elevation. Home range sizes have been recorded from 40-240 ha. The minimum patch size was defined as 2 home ranges (80 ha), using the smallest recorded range (40 ha x 2). Patch size was classified as $\geq$ 80 ha but < 2,000 ha. Core areas potentially supporting 50 or more individuals was defined as $\geq$ 2,000 ha (40 ha x 50). A number of dispersal distances have been recorded for California spotted owl (i.e. 2.3 km, 3.2 km, 5.8 km, and 7km), with a maximum dispersal distance of 72.1 km recorded using radio telemetry data.

Results & Discussion: The Least Cost Union will also likely serve the needs of the California spotted owl, since both sufficient live in and move through habitat has been incorporated into the conservation design (Figure 43). Extensive potentially suitable habitat was captured within the Least Cost Union for this species, including 2 major core areas in the Tehachapi Mountains. One core area extends from Bear Trap Canyon to just south of the city of Tehachapi, the other includes the area to the south of Bear Mountain. A number of minimum patches ($\geq$ 80 ha but < 2,000 ha) of suitable habitat also occur within the Least Cost Union in between core areas. All suitable habitat patches are within 7 km of each other, way below the maximum dispersal distance of 72.1 km recorded for the species.

Figure 43.
Potential Cores & Patches
for
California spotted owl
(Strix occidentalis occidentalis)



Legend

- Least Cost Union
- Potential Cores
- Patches
- Paved Roads
- Ownership Boundaries
- County Lines

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Burrowing owl (*Athene cunicularia*)

Justification for Selection: Burrowing owl is sensitive to habitat loss and fragmentation from agricultural and urban land uses (Grinnell and Miller 1944, Zarn 1974, Remsen 1978 *in* CDFG 1990). They are particularly vulnerable to roadkill (CDFG 1990).

Distribution & Status: Formerly common in appropriate habitat throughout the state, excluding the northwest coastal forests and high mountains. Although recorded at elevation of up to 5,300 ft (1615 m) (CDFG 1990), burrowing owls are primarily associated with low-elevation valleys (USFS 2002). The species is experiencing precipitous population declines throughout most of the western United States, and has disappeared from most of its historical range in California. Nearly 60% of California burrowing owl colonies that existed in the 1980s were gone by the early 1990s (DeSante and Ruhlen 1995, DeSante et al. 1997 *in* USFS 2002). Once widespread, its distribution is now highly localized and fragmented. It is identified as both a federal and state species of special concern.

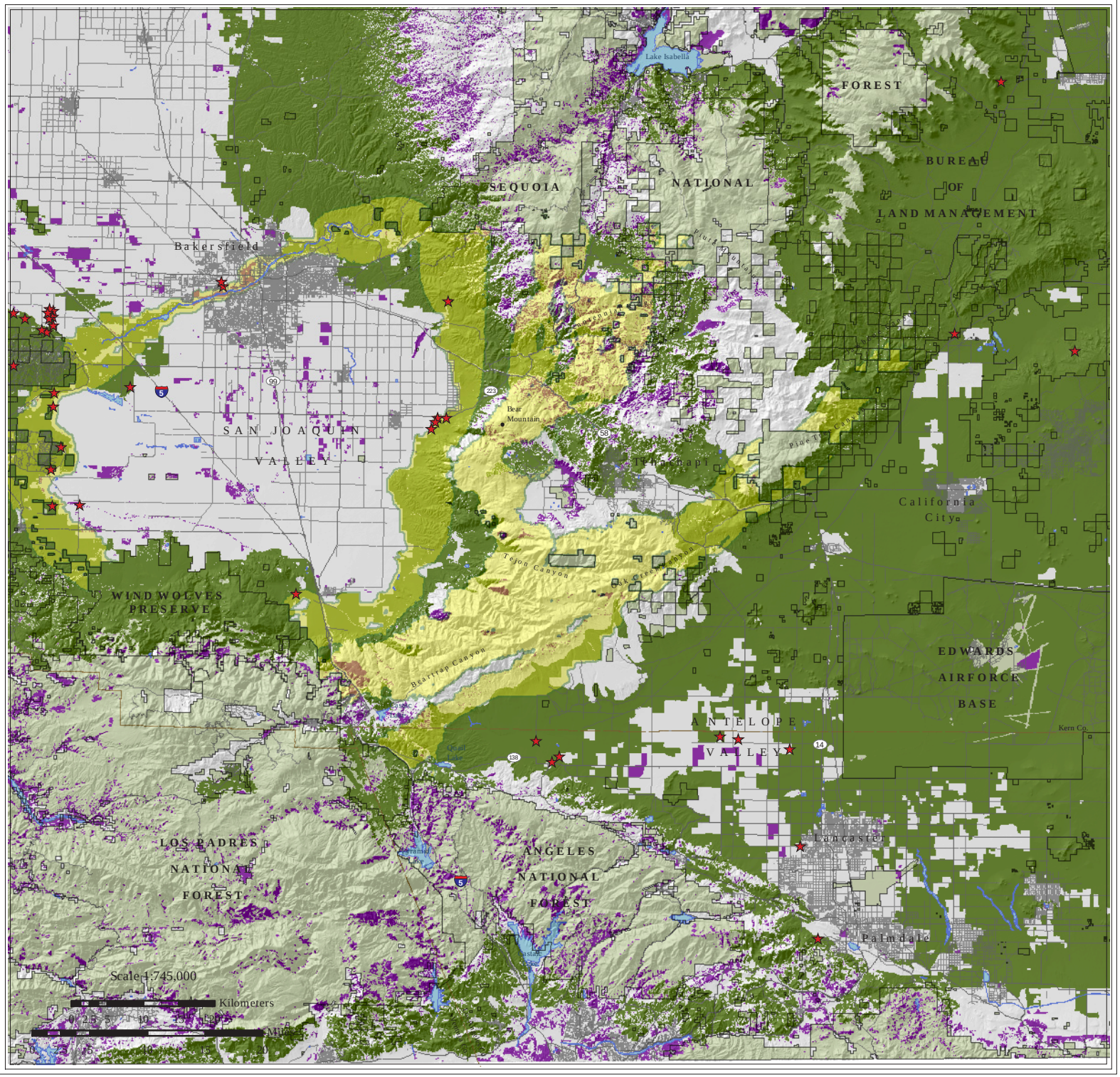
Habitat Associations: Prefers open, dry grassland and desert scrub habitats, in areas with little or no vegetation but may also inhabit open shrub stages of pinyon-juniper and ponderosa pine habitats (Small 1994). They may also occupy habitat on the fringe of agricultural areas (including pastures and untilled margins of cropland), or in other edge habitats such as the margins of airports, golf courses, and roads (Millsap and Bear 2000, Haug et al. 1993 *in* USFS 2002), though are probably relatively scarce in these environments. Key habitat characteristics include open, well-drained terrain; short, sparse vegetation; and underground burrows. They hunt in open habitats (Haug and Oliphant 1990). Throughout their range they depend on burrows excavated by fossorial mammals and reptiles for roosting and nesting (Karalus and Eckert 1987 *in* USFS 2002). Though they've also been documented using pipes, culverts, or other tunnel like structures, and nest boxes where burrows are scarce (Haug et al. 1993, Robertson 1929 *in* CDFG 1990).

Spatial Patterns: Home range sizes vary drastically, from 0.04 to 481 ha (Thomsen 1971, Haug and Oliphant 1990). Thomsen (1971) calculated home range sizes at Oakland Airport from 0.04-1.6 ha. Grant (1965) reported home ranges sizes from 4.9 to 6.5 ha, while Butts (1973) found home ranges up to 240 ha (*in* Haug and Oliphant 1990). The largest home range recorded for this species is 481 ha in Sakatchewan (Haug and Oliphant 1990). Breeding pairs in California are presumed to require a minimum of 2.6 ha of contiguous habitat (CDFG 1995 *in* USFS 2002). Natal dispersal distances up to 30 km have been reported (Haug et al. 1993 *in* USFS 2002).

Conceptual Basis for Model Development: This species prefers the open terrain of grassland and desert scrub communities below 1615 m in elevation. Minimum patch size is less than the minimum mapping unit of 1 ha, thus patch size was defined as $\geq$ than 1 ha but < 8 ha. Core areas were defined as $\geq$ 8 ha, or 50 times the minimum defined home range of 0.16 ha. Dispersal distance was defined by using twice the recorded distance of 60 km (30 km x 2).

Results & Discussion: The Least Cost Union will also likely serve burrowing owl, providing both live-in and move-through habitat. Potentially suitable core habitat captured within the Least Cost Union for this species, includes a 2-10 km wide band of habitat stretching from the Wind Wolves Preserve boundary, along the foothills and slopes of the Tehachapi and Sierra Nevada mountains up to the Kern River; scattered patches of habitat exist along the Kern River to the Elk Hills potential core area (Figure 44). Other likely core habitat areas exist along the southeastern slopes of the Tehachapi Mountains, though not all of this was captured in the Least Cost Union. All potentially suitable habitat patches are within the 30 km dispersal distance of this species.

Figure 44.
Potential Cores & Patches
for
Burrowing owl
(Athene cunicularia)



Legend

- Least Cost Union
- Potential Cores
- Patches
- CNDDB Observation
- Paved Roads
- Ownership Boundaries
- County Lines

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Acorn woodpecker (*Melanerpes formicivorus*)

Justification for Selection: The continued elimination of oaks is a threat to the existence of this species in California (Verner and Boss 1980 *in* CDFG 1990). Overgrazing causes reduced regeneration of oaks.

Distribution & Status: Acorn woodpeckers occur from northwestern Oregon, California, the American Southwest, and western Mexico through the highlands of Central America, as far south as northern Columbia (Koenig et al. 1999). They are typically found below 2100 m, though most good habitats are below 915 m in elevation (CDFG 1990).

Habitat Associations: They are residents of foothill and montane hardwood and hardwood-conifer habitats as far south as pines occur (Roberts 1979, CDFG 1990). The acorn woodpecker relies on large stands of old trees (Ligon and Stacey 1996). They excavate cavities in winter and spring in live trees or snags of oaks, sycamores, or conifers (CDFG 1990), though snags are preferred (Hooge et al. 1999). The acorn woodpecker is a highly specialized species that lives in a close association with oaks, dependent on acorns as a major food supply (Ritter 1938, MacRoberts 1970 *in* Bock and Bock 1974; Hannon et al.1987, Koenig and Mumme 1987 *in* Koenig and Haydock 1999, CDFG 1990). Oak species diversity influences the distributional limit of this species, because the probability of acorn crop failure declines with increasing oak species (Koenig and Haydock 1999). Bock and Bock (1974) found oak species richness to have a nearly exponential relationship to woodpecker abundance.

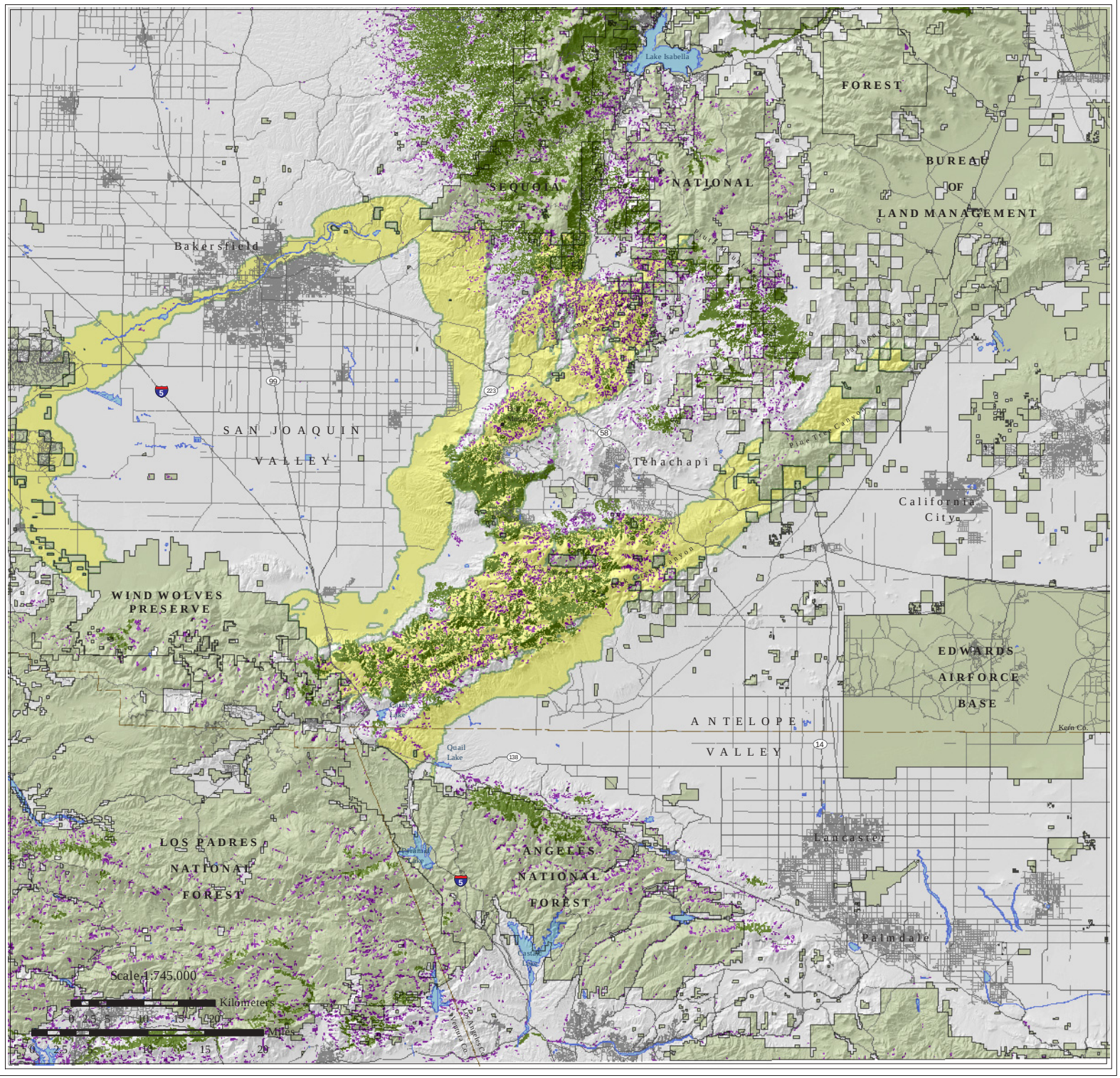
Spatial Patterns: Acorn woodpeckers are cooperative breeders that live in social groups of 2 to 15 individuals (MacRoberts and MacRoberts 1976; Koenig et al. 1995 *in* Hooge et al. 1999). Territory size is based on the key resource, the roost cavity and granary tree (Ligon and Stacey 1996). Mac Roberts and Mac Roberts (1976) found territory sizes from 3.5 to 9 ha (8.7 to 22.2 ac), while Swearingen (1977) found average territory size to be 4.7 ha (11.5 ac) in the Central Valley, with a range from 1.5 to 8.1 ha (3.8 to 20 ac) (*in* CDFG 1990). Smaller territory sizes have been recorded for the Coast Ranges (CDFG 1990).

On the western slope of the Sierras, upslope movement occurs in fall to mixed conifer habitat with black oak (Verner and Boss 1980 *in* CDFG 1990). Dispersal distances of 0.22 $\pm$ 0.48 km for males and 0.53 $\pm$ 0.52 km for females have been recorded. The usual avian pattern of greater dispersal distance by females holds true for acorn woodpeckers (Koenig et al. 2000). The maximum-recorded dispersal distance for this species is 4.3 km (Baker et al. 1995 *in* Koenig et al. 2000).

Conceptual Basis for Model Development: This species prefers mature oak woodlands and hardwood coniferous forest below 2100 m in elevation. Home ranges sizes have been recorded between 1.5-9 ha. The minimum patch size was defined as 2 home ranges (3 ha), using the smallest recorded range (1.5 ha x 2). Patch size was classified as $\geq$ 3 ha but < 75 ha. Core areas potentially supporting 50 or more individuals was defined as $\geq$ 75 ha (1.5 ha x 50). Dispersal distance was defined using twice the maximum distance (8.6 km), or 4.3 km x 2.

Results & Discussion: This species needs appear to be well accommodated by the Least Cost Union (Figure 45). The results of the analysis for acorn woodpecker also support the need to conserve the complex mosaic of hardwood and conifer habitats that occur in the Tehachapi Mountains. The spectacular diversity of oak species within the Least Cost Union provides a dependable food supply for this species. Potentially suitable core habitat for this species is distributed almost continuously from Beartrap Canyon to Cummings Mountain, including Pastorio Creek, Tunis Creek, Tejon Canyon, and Bear Mountain, virtually all potentially suitable habitat for this species was encompassed in the Least Cost Union. Another potential core area occurs in the lower Piute Mountains that wasn't captured in the Least Cost Union; there are currently scattered parcels in this area managed by the Bureau of Land Management.

Figure 45.
Potential Cores & Patches
for
Acorn Woodpecker
(Melanerpes formicivorus)



Legend

- Least Cost Union
- Potential Cores
- Patches
- Paved Roads
- Ownership Boundaries
- County Lines

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Coast horned lizard (*Phrynosoma coronatum)*

Justification for Selection: Coast horned lizard is highly sensitive to habitat loss and fragmentation, with agriculture, flood control, and urbanization cited as the main reasons for its decline (Jennings and Hayes 1994). These activities promote biological invasions by Argentine ants that eliminate native ant colonies, which the coast horned lizard is highly dependent on for sustenance (Pianka and Parker 1975, Montanucci 1989, Suarez et al. 2000 *in* Suarez and Case 2002, Fisher et al. 2002). Domestic cats can also penetrate considerable distances into otherwise suitable habitat, eliminating horned lizards within a several km² radius (Jennings and Hayes 1994). This species needs expansive roadless wildland to persist.

Distribution & Status: This California endemic has 2 subspecies whose ranges overlap; the Coast horned lizard (*P. c. frontale*) occurs on both the coastal and San Joaquin sides of the mountains and intergrades with the San Diego horned lizard (*P. c. blainvillii*) in southern Kern County and much of northern Santa Barbara, Ventura, and Los Angeles counties (Stephenson and Calcarone 1999). The known elevational range for this species is from near sea level to 1980 m at Breckenridge Mountain in Kern County (Van Denburgh 1922 *in* Jennings and Hayes 1994). The coast horned lizard was historically recorded from scattered locales from Shasta County south along the edges of the Sacramento Valley into the South Coast Ranges, San Joaquin Valley, and Sierra Nevada foothills to northern Los Angeles, Santa Barbara and Ventura counties, California (CDFG 1988, Jennings and Hayes 1994), reaching its highest densities in the relict lake sand dunes and alluvial fans of the San Joaquin Valley (Bryant 1911, Van Denburgh 1922 *in* Jennings and Hayes 1994). It has disappeared from about 35% of its historical extent, while the San Diego horned lizard is gone from nearly 45% of its former range (Jennings and Hayes 1994). The species is identified as Sensitive by the federal government and is considered a California Species of Special Concern.

Habitat Associations: The coast horned lizard frequents several vegetative communities, including inland dunes, alluvial fans, open coastal scrub and chaparral, annual grassland with scattered perennial seepweed or saltbush, and clearings in coniferous forests, broadleaf woodlands, riparian woodlands, and pine-cypress forests. However, they prefer the gravelly-sandy substrate of alluvial fans and flats dominated by alkali plants such as iodine bush (Stebbins 1985, CDFG 1988, Jennings and Hayes 1994). Essential habitat characteristics are loose, fine sandy soils, an abundance of native ants or other invertebrates, open areas for basking, and scattered low shrubs for cover and refuge (Stebbins 1985, Fisher et al. 2002). This species may utilize small mammal burrows, or tunnel into loose soils during periods of inactivity or hibernation (Jennings and Hayes 1994).

Spatial Patterns: Not much is known about home range size (CDFG 1988) or dispersal distance for this species. A recent study in 2002 however estimated home ranges size of about 0.1km^2 (Fisher et al.). Males of an associated species, P. solare, moved further than females, maximum distance for males was 30m (98 ft), while females moved a maximum distance of 15 m (49 ft) (Baharav 1975 *in* CDFG 1988).

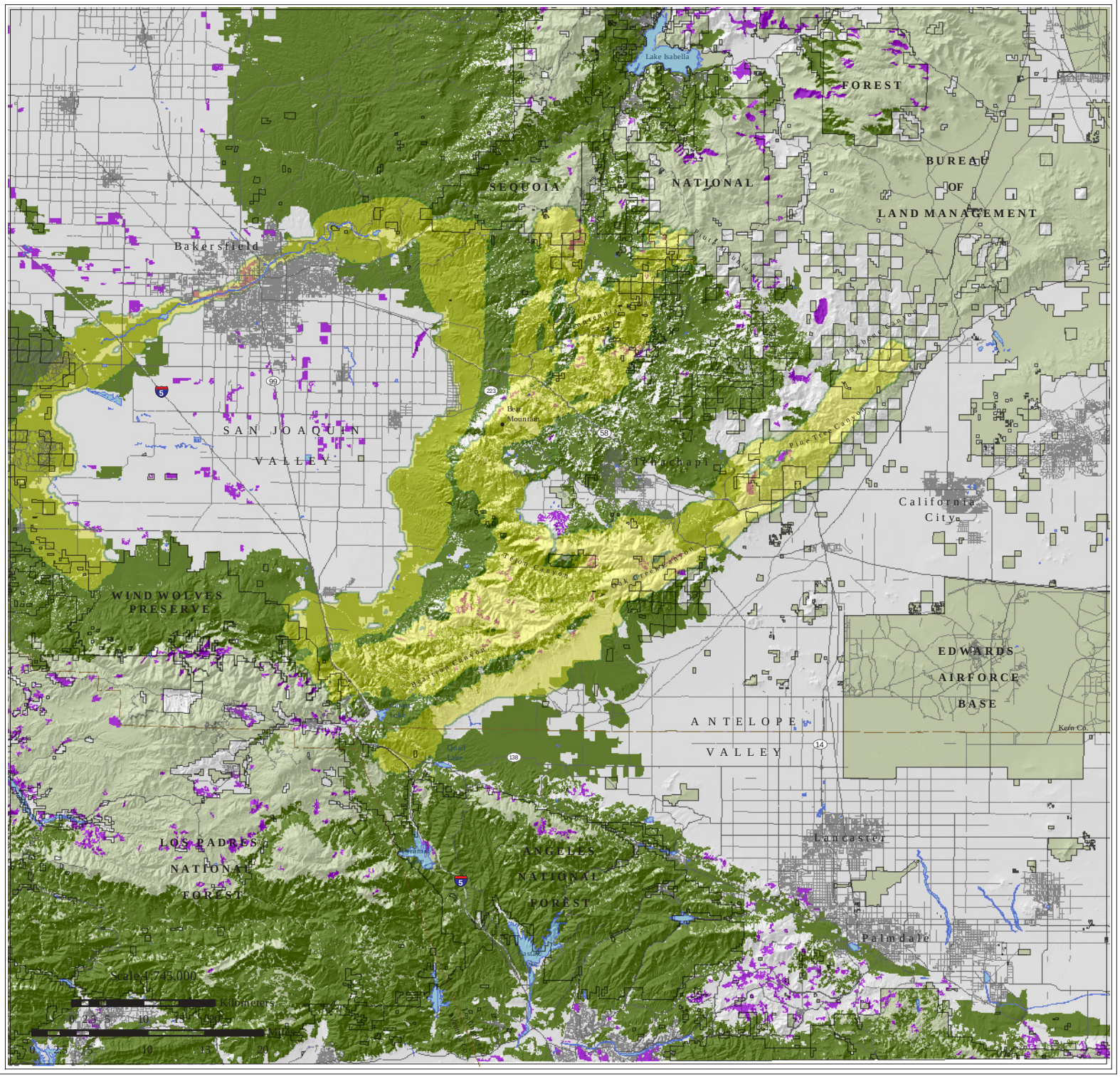
Conceptual Basis for Model Development: Movement between Core Areas in the linkage is multigenerational. They may utilize several habitat types including alluvial

fans, alkali flats, dunes, open coastal scrub and chaparral, annual grassland, and clearings in coniferous forests, broadleaf woodlands, and riparian woodlands. They avoid urban and agricultural developments and areas of high road density. The only home range estimate found in the literature was 0.1 km^2, or 10 ha. The minimum patch size was defined as 2 home ranges (20 ha), using the smallest recorded range (10 ha x 2). Patch size was classified as $\geq$ 20 ha but < 500 ha. Core areas potentially supporting 50 or more coast horned lizards are $\geq$ 500 ha (10 ha x 50). Dispersal distance was defined as 60 m, using twice the recorded distance.

Results & Discussion: This species needs appear to be well accommodated by the Least Cost Union (Figure 46). Extensive potentially suitable core habitat was captured in the Least Cost Union, contiguous habitat on the San Joaquin Valley floor, into the foothills and upland habitats of the Tehachapi Mountains (e.g. Beartrap Canyon, Tejon Canyon), to Bear Mountain, and Centennial Ridge, and in the chaparral habitats on the southeastern slopes of the Tehachapis up to Oak Creek Canyon. Other important potential core areas, not included in the Least Cost Union include Wheeler Ridge, around Quail Lake, and Emerald and Sugarloaf mountains, as well as in between both gaps in the Least Cost Union boundary.

With a dispersal distance of only 60 m, the patch configuration analysis yielded interesting results (Figure 47). Three potential interactive core areas emerged (i.e. where suitable habitat patches are within the dispersal distance); 1) Castaic, Tehachapi, Sierra Nevada, 2) Sierra Madre, and 3) the San Emigdio Ranges and Elk Hills, with the first and last being the most relevant to the linkage. Research indicates this species is more likely to persist in larger habitat patches because of its dependence on native ants, which only occur in undisturbed habitats (Suarez and Case 2002, Fisher et al. 2002). The spatial configuration of suitable habitat is also of concern because of the limited movement and dispersal capability of the species; they need large patches of suitable habitat that are in close proximity to one another (Fisher et al. 2002).

Figure 46.
Potential Cores & Patches
for
Coast horned lizard
(Phrynosoma coronatum)



Legend

- Least Cost Union
- Potential Cores
- Patches
- Paved Roads
- Ownership Boundaries
- County Lines

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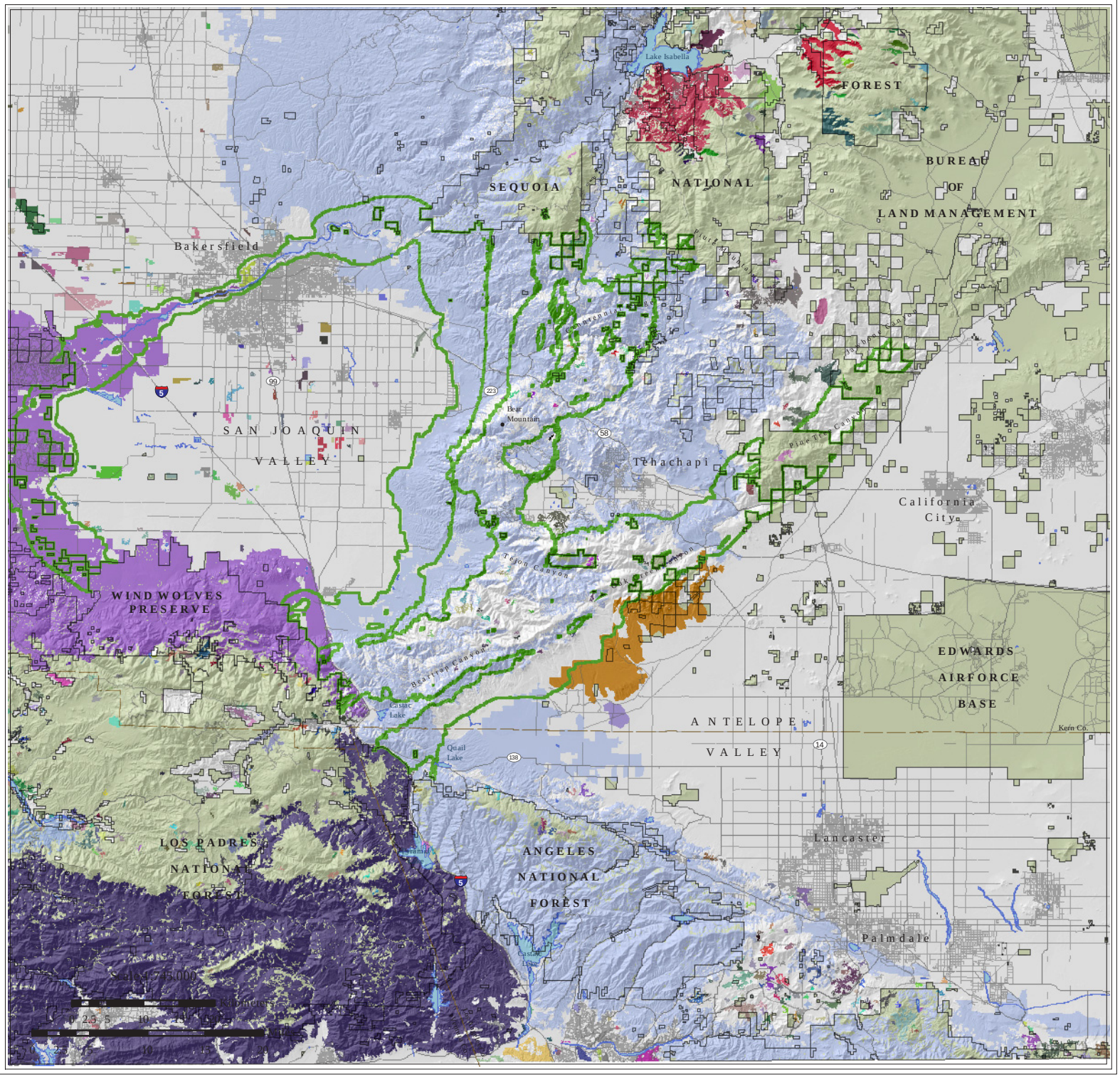
Figure 47.
Patch Configuration
for
Coast horned lizard
(Phrynosoma coronatum)



Legend

- Paved Roads
- Least Cost Union
- Ownership Boundaries
- County Lines

Colors signify patches of suitable habitat that are within twice the dispersal distance (60 m).

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Yellow-blotched Salamander (*Ensatina eschscholtzii croceater*)

Justification for Selection: Salamanders play an important role in forest ecosystems, and can be the most abundant vertebrates in their habitat (Burton and Likens 1975, Pough et al. 1987, Bury 1988 *in* Grialou et al. 2000). Logging and other land use changes may inhibit movement and dispersal capabilities of this species (Ovaska 1988, *in* Grialou et al. 2000, Stebbins 1954). Suitable habitat is needed for movement during the rainy season. Primary barriers to movement include major roads, aqueducts and large agricultural lands (M. Long, pers. comm.).

Distribution & Status: Blotched salamanders are found from southwestern British Columbia to southern California along the Pacific coast inland to the Cascades and Sierra Nevada (Rosenberg et al. 1998), at elevations ranging from sea level to around 3050 m (10,000 ft) (CDFG 1988). The yellow-blotched salamander (*E. e. croceater*) is one of 7 subspecies; it is restricted to Kern and Ventura Counties ranging from the Piute Mountains southwestward through the Tehachapi Mountains extending to the vicinity of Mount Pinos and Frazier Mountain in the Sierra Madre Range (Jennings and Hayes 1994). The Tehachapi Mountains make up a significant portion of this species range (USFS 2002) and are a contact zone between *E. e. croceater* and *E. e. klauberi*, both of which are found in oak-pine woodlands.

Habitat Association: This species occurs under downed wood and branches in montane hardwood, hardwood conifer and mixed coniferous forests (Jennings and Hayes 1994) and typically reach their highest densities in forests with deep organic soils and abundant woody debris (Rosenberg et al. 1998). In the Sierra Nevada, they have been recorded in habitats with an overstory of ponderosa pine, sugar pine, incense cedar, white fir, and black oak (Staub et al. 1995). Suitable habitat in the Sierra foothills is dominated by blue oak, interior live oak, foothill pine, California black oak, valley oak, and ponderosa pine with an understory of buckbrush, coffeeberry, toyon, and poison oak, annual and perennial grasses (Block and Morrison1998). In the Tehachapi Mountains, suitable habitat occurs in oak woodlands on north-facing slopes which may be comprised of blue oak, interior live oak, canyon live oak, California black oak, valley oak, and Brewer's oak with an understory of buckbrush, redberry, chamise, bigberry manzanita, mountain mahogany, and annual and perennial grasslands (Block and Morrison 1998). Block and Morrison (1998) found occupied habitat for this species to be highly correlated with canyon live oak and blue oak woodlands on Tejon Ranch.

Spatial Patterns: Block and Morrison (1998) placed 452 traps on Tejon Ranch in the Tehachapi Mountains at elevations ranging from 1100 to 1700 m. This species occurred in 13% of the traps, comprising roughly 39% of the individuals captured, and greater than 95% of them were found under downed logs or branches.

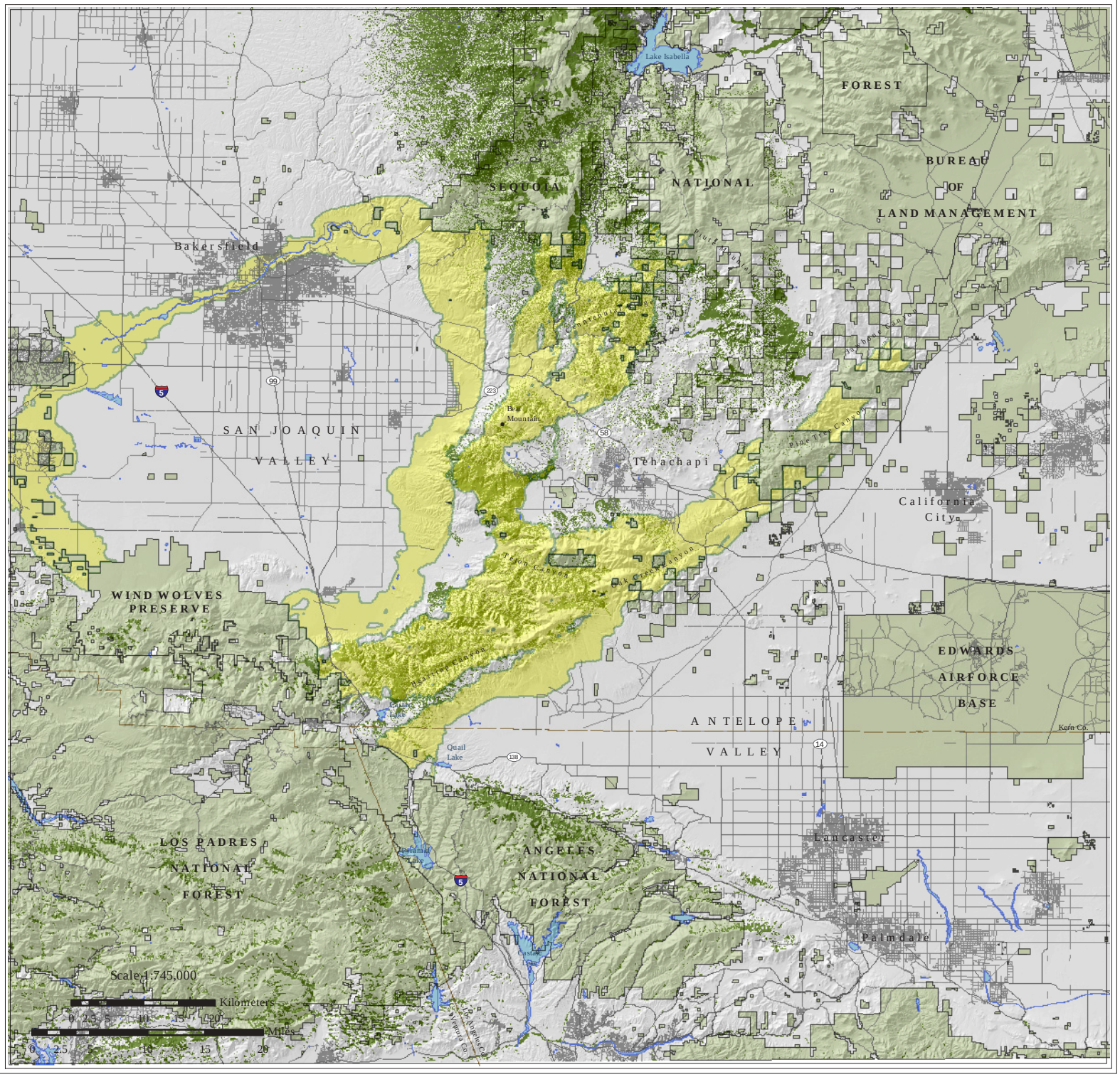
Estimated mean home ranges of 10.0 m^2 for females and 19.5 m^2 for males (Rosenberg et al. 1998). Much larger ranges were found in 1995, with females ranging up to 23 m^2 and males up to 41m^2 (USFS 2002). This species may be the most abundant vertebrate in the community, reaching densities of up to 1300 individuals per hectare in high quality habitat (Stebbins 1954, Rosenberg et al. 1998).

Movements have been estimated to average 20 m (65 ft) for mature males and 10 m (33 ft) for females (USFS 2002), though Staub et al. (1995) documented movements of up to 120.4 m for males and 60.6 m for females in the Sierra Nevada. Staub et al. (1995) found animals achieve higher rates of movement and survival in suitable habitat than in the unsuitable habitat of the matrix.

Conceptual Basis for Model Development: This species has the potential to occur in montane hardwood, hardwood conifer and mixed coniferous habitats on north-facing slopes between 200-1700 m in elevation. Home range sizes for this species have been recorded between .0006 ha and .0041 ha. Thus, estimates for minimum core area capable of potentially supporting 50 or more individuals would be 0.03 ha to 0.205 ha (minimum home range x 50). However, 1 ha is the minimum mapping unit, so all pixels of suitable habitat were defined as cores. We then evaluated which cores are within the maximum-recorded dispersal distance (120 m), and within twice the recorded distance (240 m).

Results & Discussion: The Least Cost Union is likely to serve this species. Extensive amounts of core montane hardwood and coniferous forest habitat were included in the design (Figure 48). Long-term habitat connectivity for the yellow-blotched salamander between the Sierra, Tehachapi, and Transverse Ranges depends in large part on preservation of the habitats within Tejon Ranch. This species range in this area is natural, and disturbance/development of occupied habitats could jeopardize dispersal ability of this species by fragmentation. Through both evolutionary and ecological time this area has been a major connection for dispersal of this and many other species. The patch size and configuration analysis for this species indicates there are 3 extensive core areas in the planning area, one in the Sierra Nevada, one in the Tehachapis and another along the desert slopes of the Castaic Ranges (Figure 49). All available museum records and observations of this species indicate a nearly even distribution through the Tejon Ranch lands (Jennings and Hayes 1994).

Figure 48.
Potential Cores & Patches
for
Yellow-blotched salamander
(Ensatina eschscholtzii croceater)



Legend

- Least Cost Union
- Potential Cores
- Paved Roads
- Ownership Boundaries
- County Lines

N

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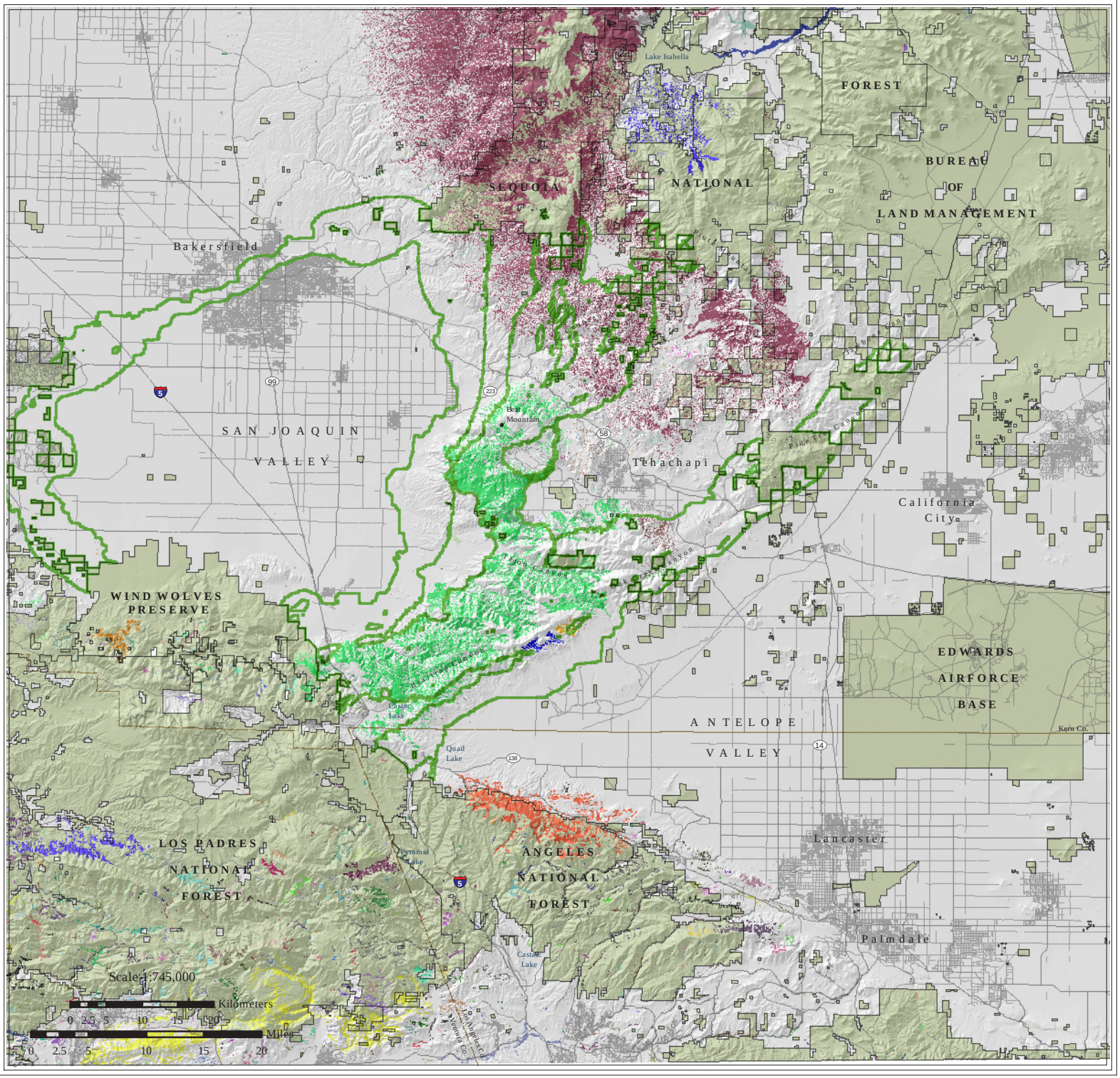
Figure 49.
Patch Configuration
for
Yellow-blotched salamander
(Ensatina eschscholtzii croceater)



Legend

- Paved Roads
- Ownership Boundaries
- County Lines
- Least Cost Union

Colors signify patches of suitable habitat that are within twice the dispersal distance (240 m).

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Long-nosed leopard lizard (*Gambelia wislizenni*)

Justification for Selection: The long-nosed leopard lizard was chosen as a representative species of desert scrub and woodland communities on the Antelope Valley side of the linkage, while the blunt-nosed leopard lizard (*G. sila*), an associated species was selected to capture habitats on the San Joaquin Valley side of the connection.

Distribution & Status: The long-nosed leopard lizard is widely distributed in the Great Basin, Mojave and Colorado deserts of California south to Baja, and west at the southern end of the Central Valley into Santa Barbara County and eastern Kern County (Stebbins 1985, CDFG 1988). This species can be found near sea level to around 1800 m (5905 ft) (Stebbins 1985, CDFG 1988).

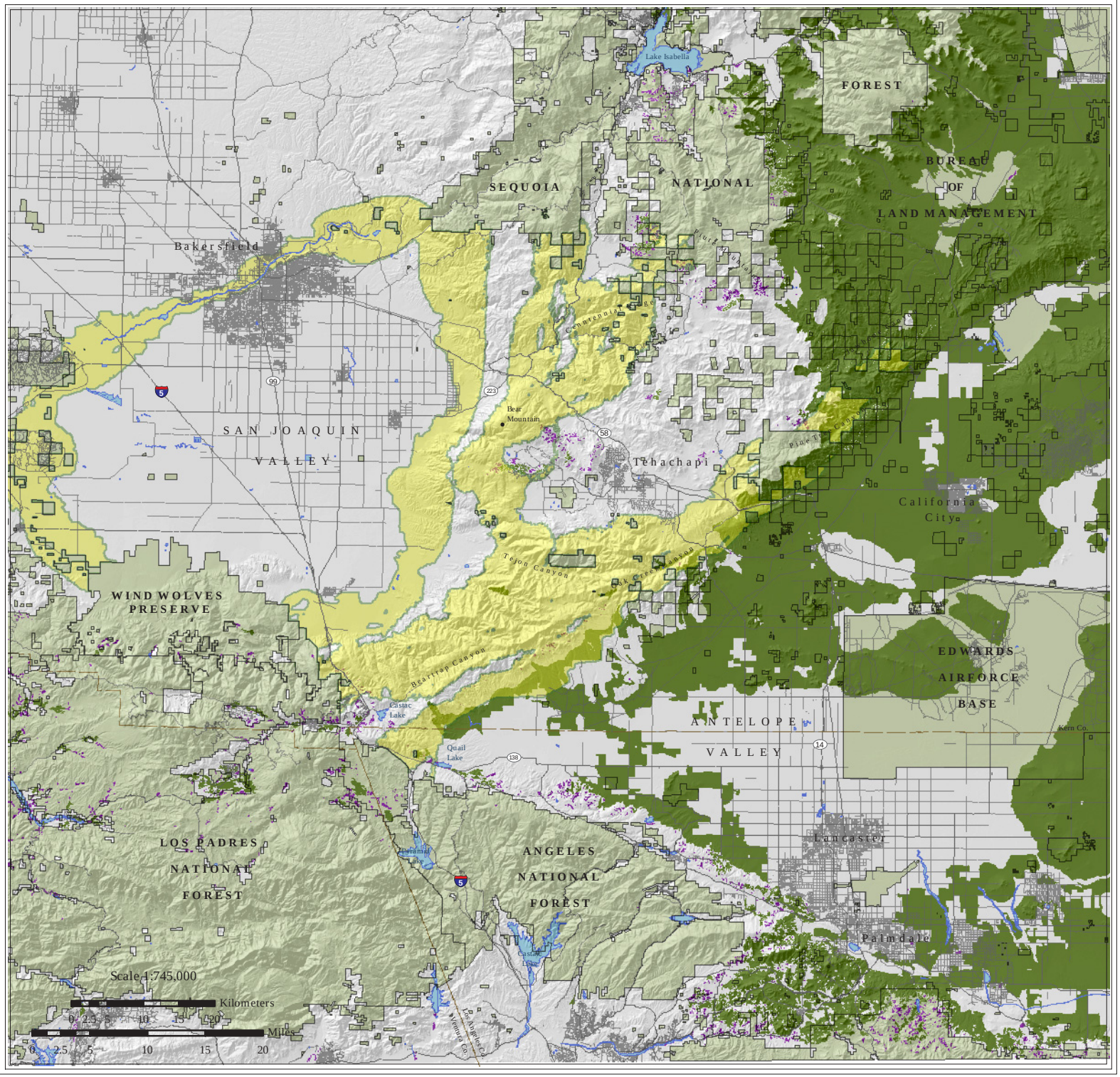
Habitat Associations: It frequents a variety of desert woodland and scrub habitats, including semiarid grasslands, alkali bush, sagebrush, and creosote bush (Stebbins 1985, CDFG 1988, Dudek and Associates undated mat.). They avoid areas with dense grass and brush (Stebbins 1985). Requires sand and friable soils to excavate burrows, preferring sandy or gravelly flats and plains; it is less common in rocky areas (CDFG 1988).

Spatial Patterns: This species is a wide-ranging predatory lizard of the desert flatlands (McCoy 1967 *in* Dudek and Associates), whose home range can be as large as several hectares (CDFG 1988). Densities vary from 5 to 19 individuals per hectare (Parker and Pianka 1976 *in* Dudek and Associates), with the greatest densities recorded in creosote flats (CDFG 1988). There is little information on dispersal or movement for this species. Parker and Pianka (1976) report long-range natal dispersal of up to 1186 m (*in* Dudek and Associates).

Conceptual Basis for Model Development: This species is associated with desert scrub, desert wash, Joshua tree and juniper woodlands, and sagebrush below 1800 m (5905 ft). Home range sizes for this species have been estimated at several hectares; we used a conservative estimate of 1 ha for home range. Minimum patch size was defined as $\geq$ 2 ha but < 50 ha. Thus, estimates for a core area capable of potentially supporting 50 or more individuals would be $\geq$ 50 ha (1 ha x 50). However, 1 ha is the minimum mapping unit, so all pixels of suitable habitat were defined as cores. We then evaluated which patches and cores are within the maximum-recorded dispersal distance (1,186 m), and within twice the recorded distance (2,372 m).

Results & Discussion: The linkage is on the edge of this species distribution, yet based on the output from the patch size and configuration analyses; it appears that this species is at least marginally accommodated by the Least Cost Union (Figure 50). The desert scrub and pinyon-juniper habitat on the southeastern slopes of the Tehachapi Mountains, extending from the Quail Lake area to Oak Creek, Pine Tree and Jawbone canyons, was captured in the Least Cost Union. Extensive potentially suitable habitat occurs outside of the Least Cost Union in the desert scrub communities of the Antelope Valley.

Figure 50.
Potential Cores & Patches
for
Long-nosed leopard lizard
(Gambelia wislizenii)



Legend

- Least Cost Union
- Potential Cores
- Patches
- Paved Roads
- Ownership Boundaries
- County Lines

N

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Callippe fritillary (*Speyeria callippe*)

Justification for Selection: Callippe fritillary is sensitive to habitat alteration from urban development (Orsak 1977).

Distribution & Status: There are a number of different subspecies, 3 of which occur in Kern County (K. Davenport and G. Pratt pers. comm.). This subspecies (*S. c. macaria*) occurs from the Mt. Pinos area through the Tehachapi Mountains to the Greenhorn and Piute mountains at the southern end of the Sierra Nevada Range, and south to Bouquet Canyon (Emmel and Emmel 1973).

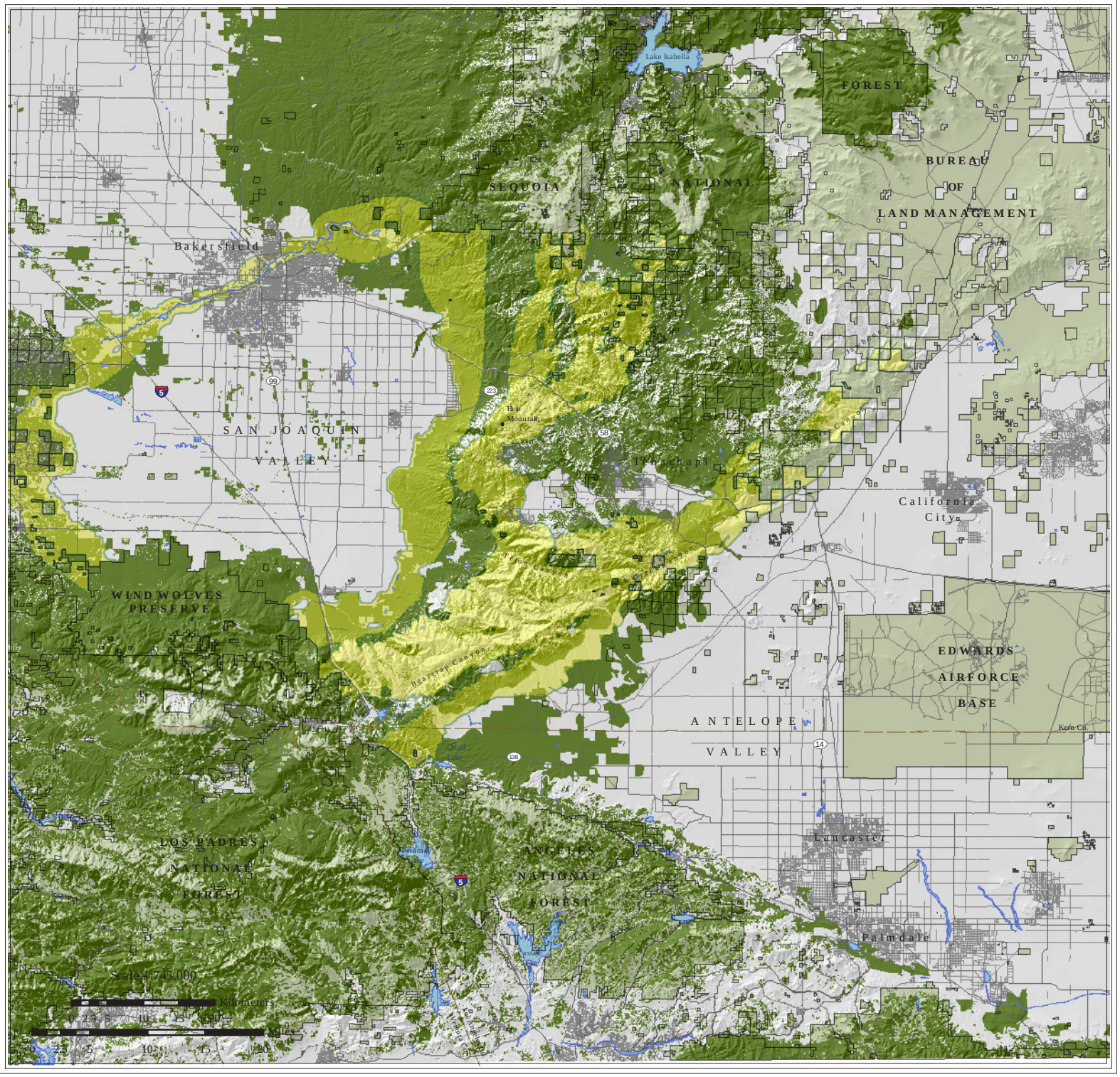
Habitat Associations: This subspecies has one flight from late May to July and emerges earlier than other *Speyeria* species occurring in the same locality (Emmel and Emmel 1973). It has been recorded in open pine and oak woodlands, sagebrush, chaparral, and grassland habitats and may be found on hillsides, in canyons and meadows (Emmel and Emmel 1973). They may fly in mixed coniferous forests at up to 8,000 feet but they don't oviposit above 6500 feet. They ovideposit in spring and larvae are dormant until the following winter (K. Davenport and G. Pratt pers. comm.). Larvae hostplants are members of the genus *Viola* spp. that occur in moist places. Females deposit eggs under shrubs where *Viola* will come up the next spring for larvae to feed on the leaves (Scott 1986). Adults visit violets in spring, but also utilize wallflower and yerba santa as nectar sources (K. Davenport and G. Pratt pers. comm.). Males seek hilltops and ridges to await unmated females (Orsak 1977, Scott 1986).

Spatial Patterns: No density estimates exist for this species but in three other members of the genus, abundance was positively correlated with abundance of the *Viola* host plant (Fleishman et al. 2002). Rapid increases on host plants in wet years (Emmel and Emmel 1973) suggest that individuals are good dispersers and quickly colonize host plant populations. Other species in this genus also show this propensity where density is best modeled as a consequence of habitat quality rather than patch area or degree of isolation (Fleishman et al. 2002). Other habitat specialists in the genus have also been observed to preferentially avoid crossing habitat edges into other habitat types, including crops and roads (Ries and Debinki 2001). Adults are low but fast flyers (Emmel and Emmel 1973) capable of 30-mile movements (K. Davenport and G. Pratt pers. comm.).

Conceptual Basis for Model Development: No home range or density estimates were found in the literature; therefore only potentially suitable habitat was delineated. Movement between protected core areas in the linkage is multigenerational. This butterfly regularly disperses up to 10 km and potentially up to 30 km and prefers to move through open habitats (open oak and riparian woodlands, chaparral, coastal sage, and grasslands). It will disperse through other native habitats, but avoids agricultural and urban landscapes. Extensive developed areas, even wide freeways, are likely barriers since this species avoids leaving suitable habitats.

Results & Discussion: Callippe fritillary appears to be well served by the Least Cost Union. The model output suggests that highly suitable for this species occurs primarily on the northwest and southeast slopes of the Tehachapi Mountains, likely providing both live-in and move through habitat between protected habitat in the Sierra Nevada and Sierra Madre ranges (Figure 51).

Figure 51.
Potential Cores for
Callippe Fritillary
(Speyeria callippe macaria)



Legend

- Least Cost Union
- Potential Cores
- Paved Roads
- Ownership Boundaries
- County Lines

N

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San Emigdio Blue Butterfly (*Plebejus emigdionis*)

Justification for Selection: This species is sensitive to habitat loss and fragmentation from urban development and roads. Roads are likely barriers for this species.

Distribution & Status: The San Emigdio blue butterfly is a very local and rare species in southern California from Inyo County south through the Mojave Desert, San Joaquin Valley, in isolated scattered colonies in the lower portion of Owens Valley, and in Bouquet and Mint Canyons in the Castaic Range (USGS undated mat.). There are known to occur in canyons along the north side of the San Gabriel Mountains near the desert's edge, and in arid areas south of Mount Abel near San Emigdio Mesa (Emmel and Emmel 1973, Murry 1990). In the planning area, the species has been documented in Cache Creek and Sand Canyon in the Tehachapis, Soledad Canyon, Hungry Valley, 9 mile Canyon, and on Wind Wolves Preserve (K. Davenport and G. Pratt pers. Comm.). This species isn't afforded any special status.

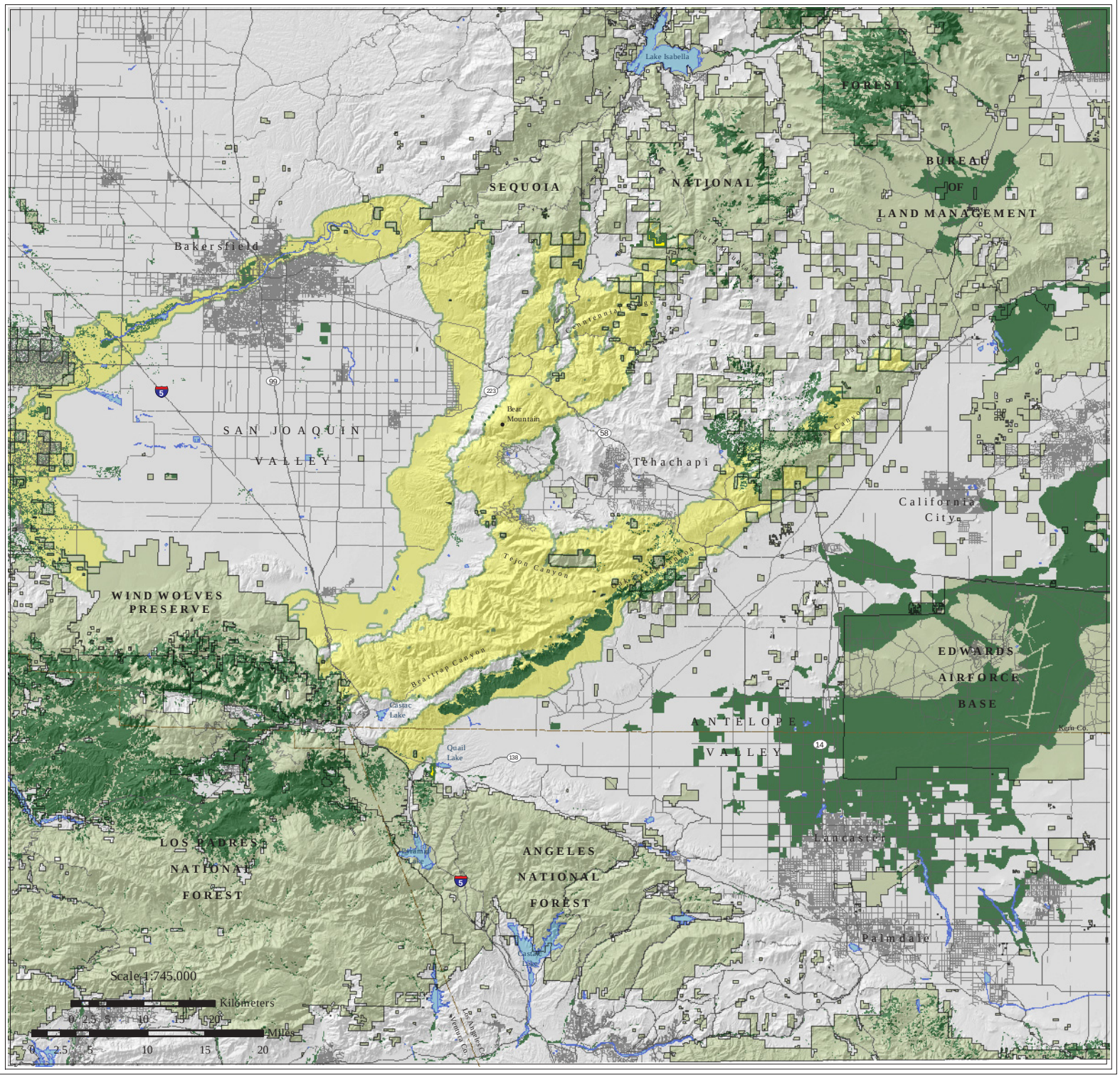
Habitat Associations: This species occurs in shadscale scrub in desert canyons, near washes, and riparian areas. It is closely associated with the widespread saltbush *Atriplex canescens* in alkali sink areas and mostly intermittent streams (Murry 1990, Garth and Tilden 1986). The butterfly's distribution is more localized than the host plant, suggesting other factors may determine habitat suitability. One limiting factor lies in the fact that a particular species of ant tends the larvae of the San Emigdio blue butterfly, the ant benefiting from honeydue produced by the larvae, and the larvae benefiting when ants ward off predators and parasitoids (Osborne pers. Comm.). The host plant *Atriplex canescens* leaves are fed on by the larvae and adults on the nectar (USFS 2002).

Spatial Patterns: This small blue butterfly has been known to reach distances of 1km, although data on dispersal is inconsistent (K. Davenport and G. Pratt pers. Comm. However, species in the same genus, P. icarioides (Lupine blue) have been recorded flying an average distance of 27 m for males, and 32 m for females, longest distance recorded 162 m over their 8 day life span (Scott 1986). Most males in this genus patrol areas with high concentrations of their host plant all day to seek females (Scott 1986).

Conceptual Basis for Model Development: Movement between protected core areas in the linkage is multigenerational. The host plant may occur in alkali desert scrub, bitterbrush, desert and montane riparian, desert wash, and pinyon juniper woodland. This butterfly regularly visits river and creek beds, making for good corridors. Good nectar plants and yellow flowers may help this species to move between patches. Roads are likely barriers since this species flies low to the ground. Dispersal distance was defined as 1 km.

Results & Discussion: The model identified several large patches of potentially suitable habitat for this species in the planning area. The Least Cost Union captured 2 significant blocks of habitat for this species, on the southeastern slopes of the Tehachapi Mountains, and on the lower slopes of Sugarloaf Mountain (Figure 52). However, these two patches were determined to be beyond the dispersal distance for this species. Nevertheless, the linkage is likely to provide this species with live-in habitat.

Figure 52.
Potential Cores for
San Emigdio blue butterfly
(Plebulina emigdionis)



Legend

- Least Cost Union
- Potential Cores
- Paved Roads
- Ownership Boundaries
- County Lines

N

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Bear Sphinx moth (*Arctonotus lucidus*)

Justification for Selection: This species is sensitive to habitat loss and degradation from urban development, and also affected by light pollution. They require extensive landscapes with little or no disturbance, development and artificial light (K. Osborne pers.comm.). Cattle grazing may also impact this species due to the loss of host plants.

Distribution & Status: In California this moth can be found locally in foothill regions of the San Gabriel, Western Sierra Madre, Coast Ranges, and the Tehachapi Mountains (K. Osborne pers.comm.). Populations of this species occur in and around the Central Valley rim between 500 ft and 4500 ft in elevation (K. Osborne pers.comm.). They have been recorded from the bottom of the Grapvine in Central Valley, and in the vicinity of Fort Tejon, Lebec, and Gorman (K. Osborne pers.comm.). This species isn't afforded any special status.

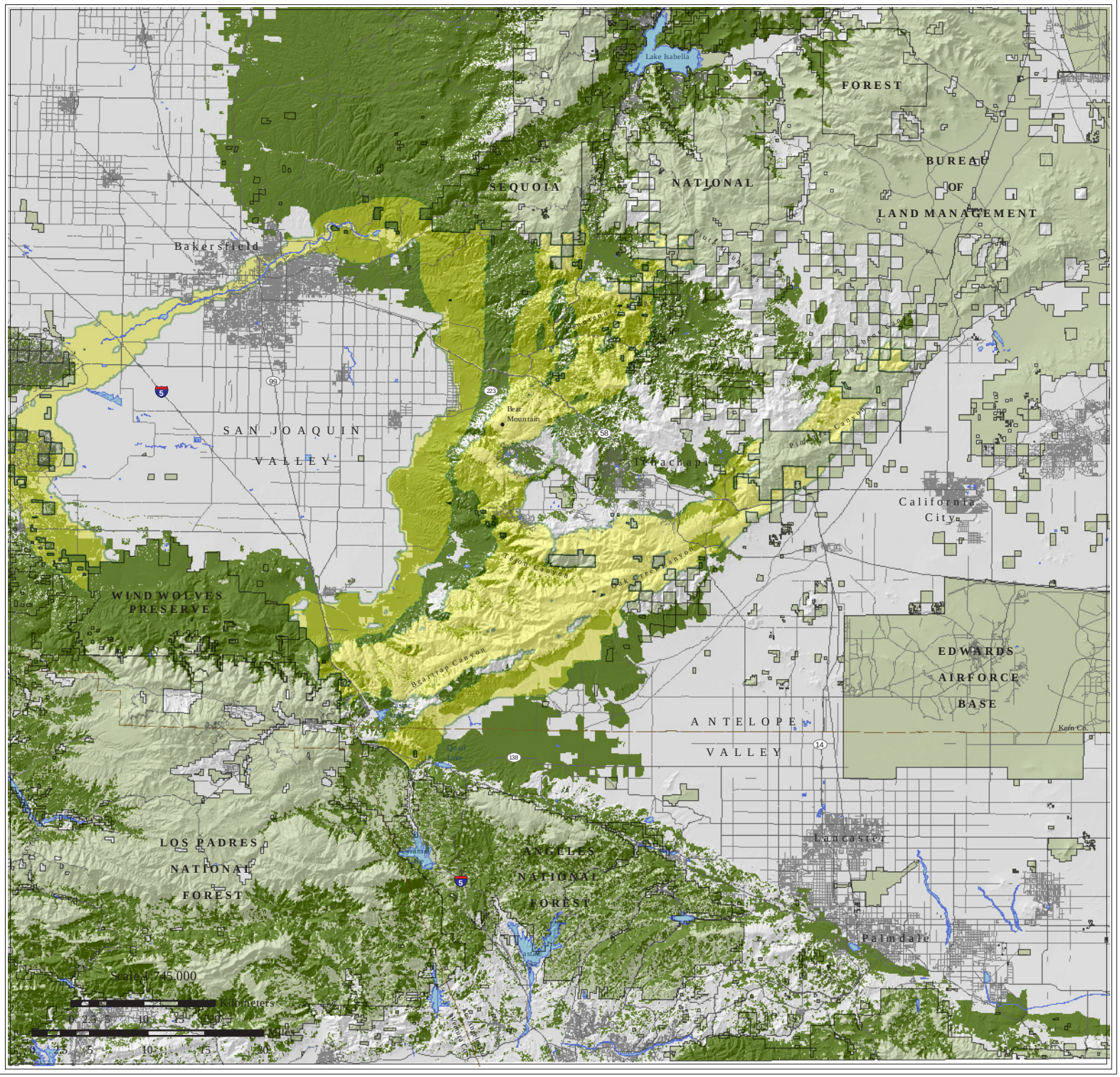
Habitat Associations: Oak woodlands and grasslands are typical habitats of this species, which is found in broad and undeveloped woodlands, hills, and canyons (K. Osborne pers.comm.). Larvae feed on plants of the evening primrose family (Comstock and Henne 1942) such as *Clarkia* and *Camissonia* species (Osborne 2000). Species in the *Clarkia* genus may be found in the following vegetation communities: annual grassland, perennial grassland, blue oak woodland, blue oak-foothill pine, Jeffrey pine, chaparral, mixed chaparral, montane chaparral, chamise-redshank chaparral, Upper Sonoran Subscrub, pinyon juniper, and juniper woodlands (Twisselman 1967).

Spatial Patterns: No home range data was found in the literature. Adults fly during the early evening, into night, in foothill woodland and grassland habitats. The bear sphinx moth may fly up to a few kilometers, however this is based solely on relative numbers of observations associated habitat versus out-of-habitat during flight seasons (K. Osborne pers. Comm.).

Conceptual Basis for Model Development: This species prefers oak woodland and grassland communities but may also utilize other habitats where food plants occur in abundance, including open coniferous forests, chaparral, and desert scrub and woodland communities, between 500-4500 feet in elevation. Urban and agricultural areas may be important impediments due both to habitat alteration and adult attraction to artificial light sources. Since no home range estimates were found in the literature, all patches of suitable habitat 1 ha or greater were used in the analysis. Dispersal distance was defined as 2 km.

Results & Discussion: The linkage is likely to serve this species since extensive blocks of potentially suitable habitat were incorporated into the linkage design (Figure 53). Wide linkages are important to allow free dispersal and gene flow across populations. Bear sphinx appears generally distributed through the Grapevine Canyon, Gorman pass, and valleys to the east and west, due to an abundance of Clarkia host plants in this area. All potentially suitable habitat patches are within twice the dispersal distance of this species. This is a species of wide open landscapes. Small "core" areas of a few square kilometers linked by thin "corridors" would likely not suffice in maintaining this species (K. Osborne pers. comm.).

Figure 53.
Potential Cores for
Bear sphinx moth
(Arctonotus lucidus)



Legend

- Least Cost Union
- Potential Cores
- Paved Roads
- Ownership Boundaries
- County Lines

N

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Linsley's rain beetle (*Pleocoma linsleyi*)

Justification for Selection: Linsley's rain beetle is restricted to the Tehachapi Mountains and the San Andreas rift zone.

Distribution & Status: *Pleocoma linsleyi* was described (Hovore, 1971) from near the northern crest of the Old Ridge Route (N-2), close to the site of the old Sandbergs hotel. The species ranges throughout the Tehachapi Mountains and along the San Andreas fault zone west to the slopes and ridges surrounding Mt. Pinos, and east to at least Lake Hughes, wherever suitable soils and vegetation occur. The overall distribution of the species suggests an ancient original distribution, probably pre-Miocene, with subsequent fragmentation by orographic changes, including fault movement. This species isn't afforded any special status.

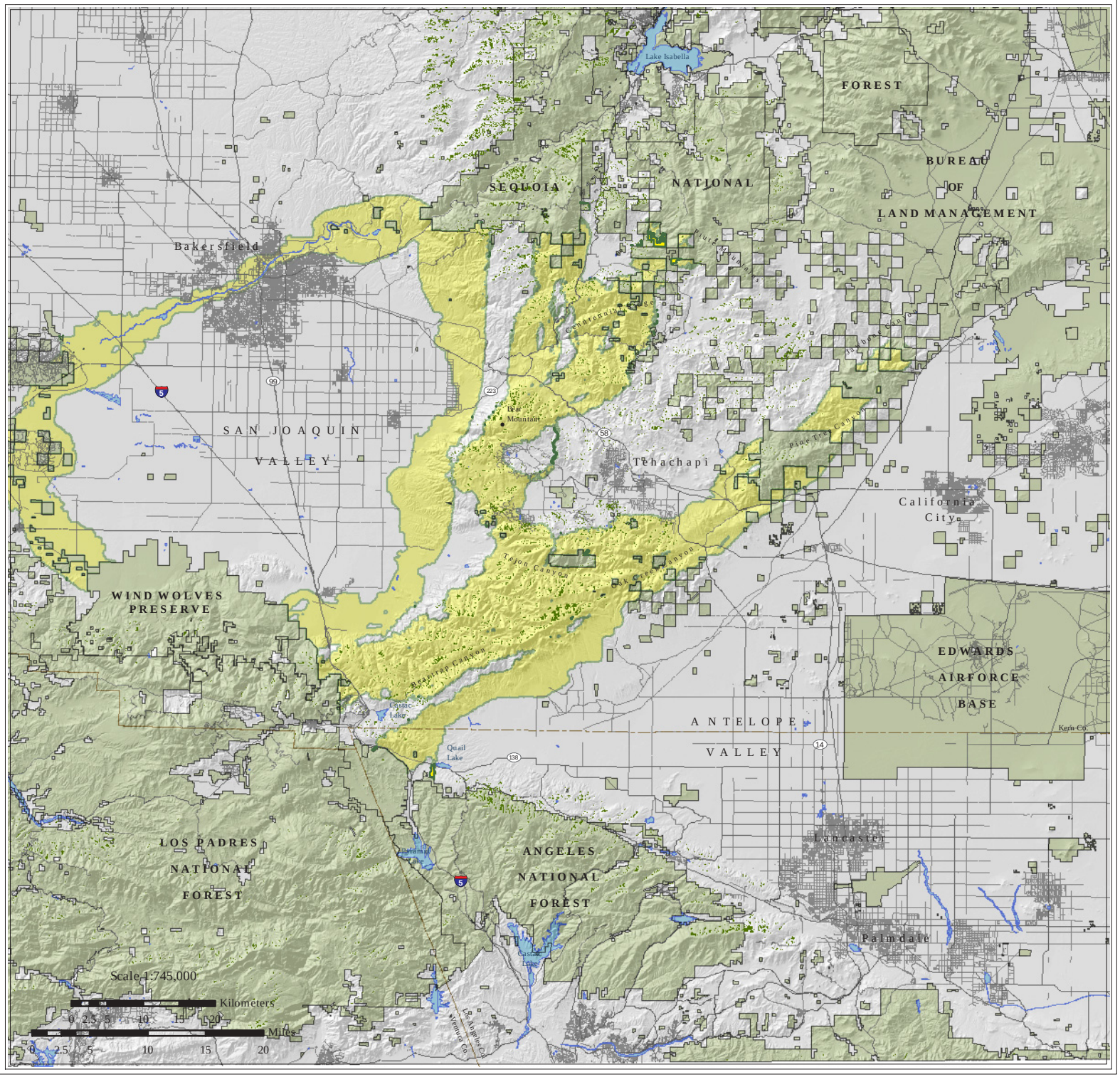
Habitat Associations: Larvae of *Pleocoma* live within the soil, usually within bands with heavy clay content, and feed upon roots of a variety of plants. *Pleocoma linsleyi* larvae appear to favor canyon oak (Quercus chrysolepis) as the primary host, where available, but are not necessarily restricted to this species. Collections from the slopes of Mt. Pinos strongly suggest that *P. linsleyi* occurs not so much in association with any particular habitat or host plant type, but more likely where soils provide a suitable substrate for larval movement and development. While canyon oak appears to be the preferred larval host at many localities, some higher elevation collection sites on Mt. Pinos, possess only scattered *Q. kelloggii*, *Q. berberidifolia*, or no oak species of any kind, and are open, park-like mixed conifer forest (F. Hovore, pers. comm.).

Spatial Patterns: Female *Pleocoma* are flightless and move only short distances through the soil during their emergence and mating activities. Metapopulations therefore tend to be limited in extent to areas of suitable sub-soils and hosts, and appear to be concentrated, if not restricted, to north-facing slopes and steeper canyons. Males are capable of strong flight, and can easily cross such obstacles, which provides some genetic dispersal, but larvae and female beetles are limited to substrate travel, and cannot cross impenetrable surfaces. The precise parameters of any given population cannot easily be determined, but some units may be very limited in areal extent, while others may spread across relatively broad areas of suitable substrate and hosts (F. Hovore, pers. comm.).

Conceptual Basis for Model Development: No home range estimates have been developed for this species; therefore only potentially suitable habitat was delineated. Movement in the linkage would be by males flying between habitat areas, which probably occur only rarely, and females of this species are unable to disperse across any sort of unnatural barrier. Major landform breaks (deep canyons, exposed rock, rivers, lakes, etc.) are significant barriers to *Pleocoma* movement, as would be freeways, concrete channels, aqueducts, etc. (F. Hovore, pers. comm.).

Results & Discussion: The species would likely be served by the Least Cost Union since the distribution is relictual, and probably entirely natural (Figure 54). There is no way of determining the potential for population maintenance via linkages *a priori*, but male dispersal probably would occur occasionally between the patches. Minor surface changes likely do not extirpate *Pleocoma*, but excavation and creation of hardscape

Figure 54.
Potential Cores for Linsley's rain beetle
(Pleocoma linsleyi)



Legend

- Least Cost Union
- Potential Cores
- Paved Roads
- Ownership Boundaries
- County Lines

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barriers would be significant to population dispersal and persistence. This species probably can persist locally within a sequence of relatively small habitat patches, provided that the overall linkage is “tight” enough to provide regular gene exchange between patches (F. Hovore, pers. comm.).

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Tejon rabbitbrush longhorned borer (*Crossidius coralinus tejonicus*)

Justification for Selection: This subspecies is restricted to a small area of suitable habitat in the Tejon Pass, and is susceptible to land use changes such as urban development, late-season wildfire, or agriculture.

Distribution & Status: *Crossidius coralinus* is distributed across the western U.S. in two separate population groups, one raning through the desert areas of the Great Basin, and the other confined to the Central Valley and northern Transverse Ranges of California (Linsley & Chemsak, 1961; Linsley, 1962). There are 13 described subspecies, three of which occur in Kern County: *Crossidius coralinus ascendens* ranges through the western Antelope Valley; *C.c. ruficollis* is confined to the lowlands of the southern San Joaquin Valley; and *C.c. tejonicus*, which is known only from the Tejon Pass (Lebec, Frazier Park) to nearby portions of Cuddy Creek valley. This species is afforded no special status.

Habitat Associations: The larval host is *Chrysothamnus nauseosus mojavensis*, a shrubby species of rabbitbrush; the larvae bore within the living root systems. The subspecies in the Antelope Valley also uses this larval host, but the *ruficollis* subspecies utilizes several different species of *Isocoma* as it larval host (Linsley & Chemsak, 1961; F.Hovore file data). Rabbitbrush tends to colonize recently-disturbed substrates, and so is most often found on low-gradient alluvial fans, in association with sage scrub formations, but it also may be common around the periphery of agricultural areas, along roadsides, and in pastures. The longhorned borers are closely-linked ecologically to their larval host plants, and generally occur with them over a range of substrate conditions, but usually are not present in seasonally inundated soils (F.Hovore file data).

Spatial Patterns: No density studies have been conducted, but the ratio of beetles to host plants observed in the field has ranged from 1:1 to perhaps as many as 6:1. The age and root stock size of the host plants likely influences the density of individuals within any host patch. Dispersal distances have not been measured, but the adult beetles are strong fliers, and wary of approaching predators, and likely can cross distances of many miles in search of new host plant resources.

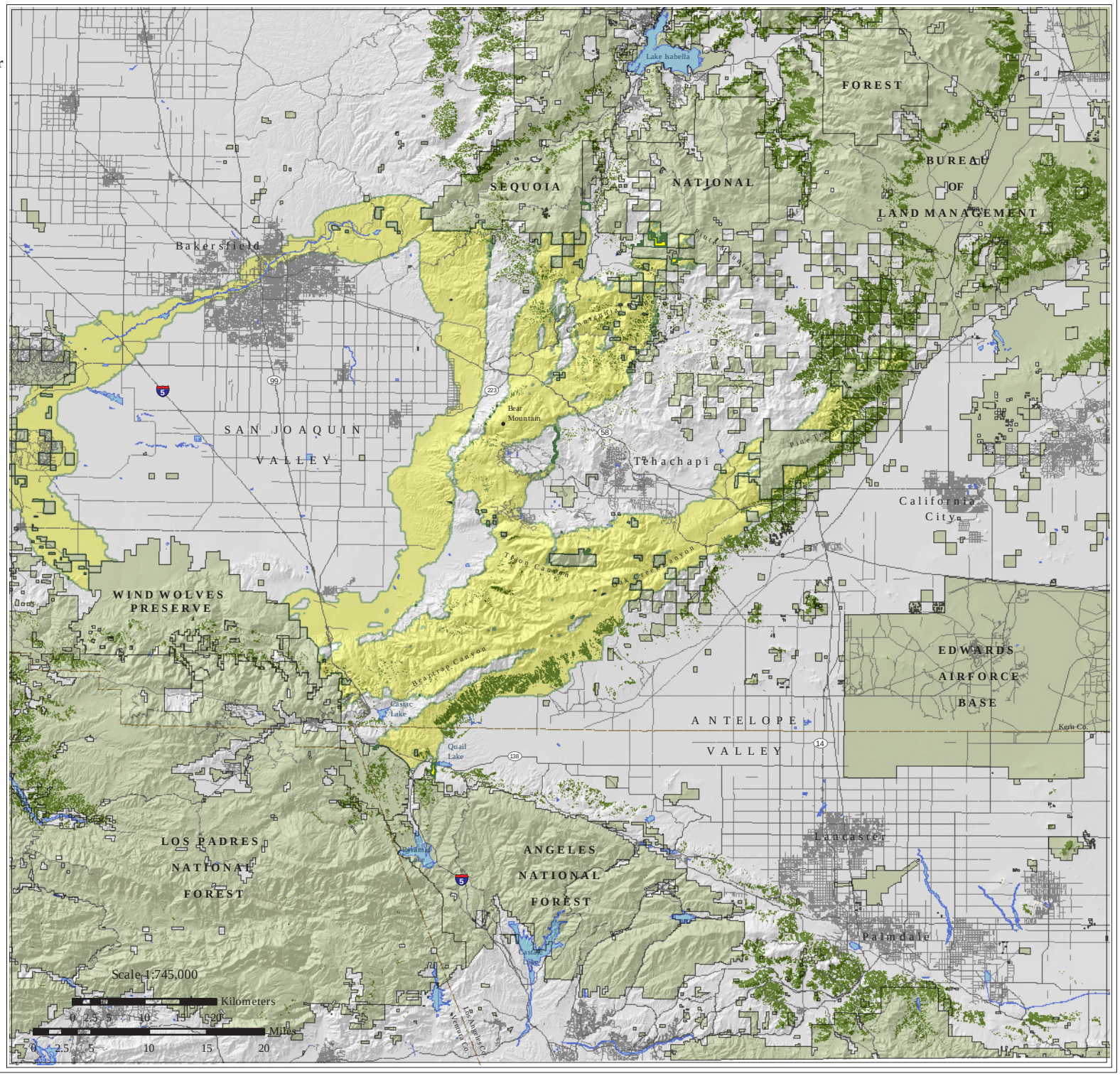
Conceptual Basis for Model Development: No home range or density estimates have been developed for this species; therefore only potentially suitable habitat was delineated. Movement through the linkage would have to be multigenerational, but it is unlikely that this species would disperse beyond its present known distributional parameters because of shifts in host plant availability. If it were to move east across the rift zone, it would encounter the subspecies *ascendens* in the Antelope Valley, on the same host, and if it co-mingled with that taxon to any extent, subspecies identity likely would break down. Movement to the north would take it into the range of the subspecies *ruficollis*, on a different host genus, and it likely would not successfully colonize and compete with that taxon. The present array of discreet, geographically segregated subspecies in *Crossidius coralinus* strongly suggests that the described populations do not interact genetically to any significant extent.

Results & Discussion: Given the evidence that these subspecies do not ebb and flow significantly within short time frames, the linkages appear to be sufficient for their

persistence (Figure 55). Because the larval host plant shifts demographically with disturbance, it would seem that the linkage would provide sufficient opportunity for persistence (F. Hovore, pers. comm.). The probable dispersal distance, with help from wind, likely is sufficient to move between any and all patches.

The presumption is that this species was distributed over more of the landscape prior to pre-historic isolation of the habitats around the San Joaquin Valley, which have lead to separation of the species into isolated populations. Its specific distribution follows its host, which follows disturbance, but its overall distribution is relictual within the upper valleys of the Tejon Pass. Disturbance on a small scale, and not followed by land use changes which restrict its host plant from colonizing the substrates, would favor it; large-scale change likely would not.

Figure 55.
Potential Cores for
Tejon rabbitbrush longhorned borer
(Crossidius coralinus tejonicus)



Legend

- Least Cost Union
- Potential Cores
- Paved Roads
- Ownership Boundaries
- County Lines

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Lined *Lomatium* longhorned borer (*Brachysomida vittigera*)

Justification for Selection: This species is presently is known from only a few scattered localities along the western foothills of the San Joaquin Valley, in association with its putative larval host plant, a small, dark-flowered species of *Lomatium*.

Distribution & Status: *Brachsomida vittigera* was described (Linsley & Chemsak, 1972) from four total specimens, one from Lebec, Tejon Pass; one from 15 mi SW Havilah, Kern Co.; and two badly preserved specimens from "Colony Road, Tulare Co." [probably near Kaweah] Since that time, it has been taken in only one other reported site, approximately 1 mile E of Fountain Springs, in association with an undetermined species of *Lomatium* (F.Hovore file data). The probable overall range of the species is from the north slope of Tecuya Ridge and Tejon Pass across the low foothills of the Tehachapi and southern Sierra Nevada to the Fresno County (or perhaps even further north). This species is not afforded any special status.

Habitat Associations: The presumed larval host plant (Lomatium sp.) and the beetle have been found together on north-facing slopes of low knolls in open grassland – rangeland, just below the limit of valley oak savannah on the eastern foothills of the San Joaquin Valley. Soils are heavy, dark clays, densely overgrown in most areas with non-native grasses, and the beetles tend to be distributed only where native wildflowers are able to form small stands within the grasses. Males fly in search of females, which are much heavier-bodied, and apparently unable to fly (F. Hovore, pers. comm.).

Spatial Patterns: No density studies have been conducted, but the beetles can be fairly common within even small patches of the Lomatium, suggesting that the larvae likely feed externally upon roots and rootlets, and not within the main root or stem. A patch of only a few hundred plants, covering approximately $100m_2$ may yield several dozen adult beetles at any given time, suggesting that over the entire period of adult emergence several hundred beetles may be present therein. If females cannot fly, though, genetic dispersal would be by males flying between patches, but metapopulation movement would occur incrementally over longer periods of time (F. Hovore, pers. comm.).

Conceptual Basis for Model Development: Movement in the linkage would be by males flying between habitat areas, which may not occur with any frequency, and it is unlikely that females of this species are able to disperse across any sort of unnatural barrier. The overall distribution, however, suggests that it must be capable of moving through areas of unsuitable habitat to find the larval host plant, or that it utlizes host other than the observed species of *Lomatium* (F. Hovore, pers. comm.).

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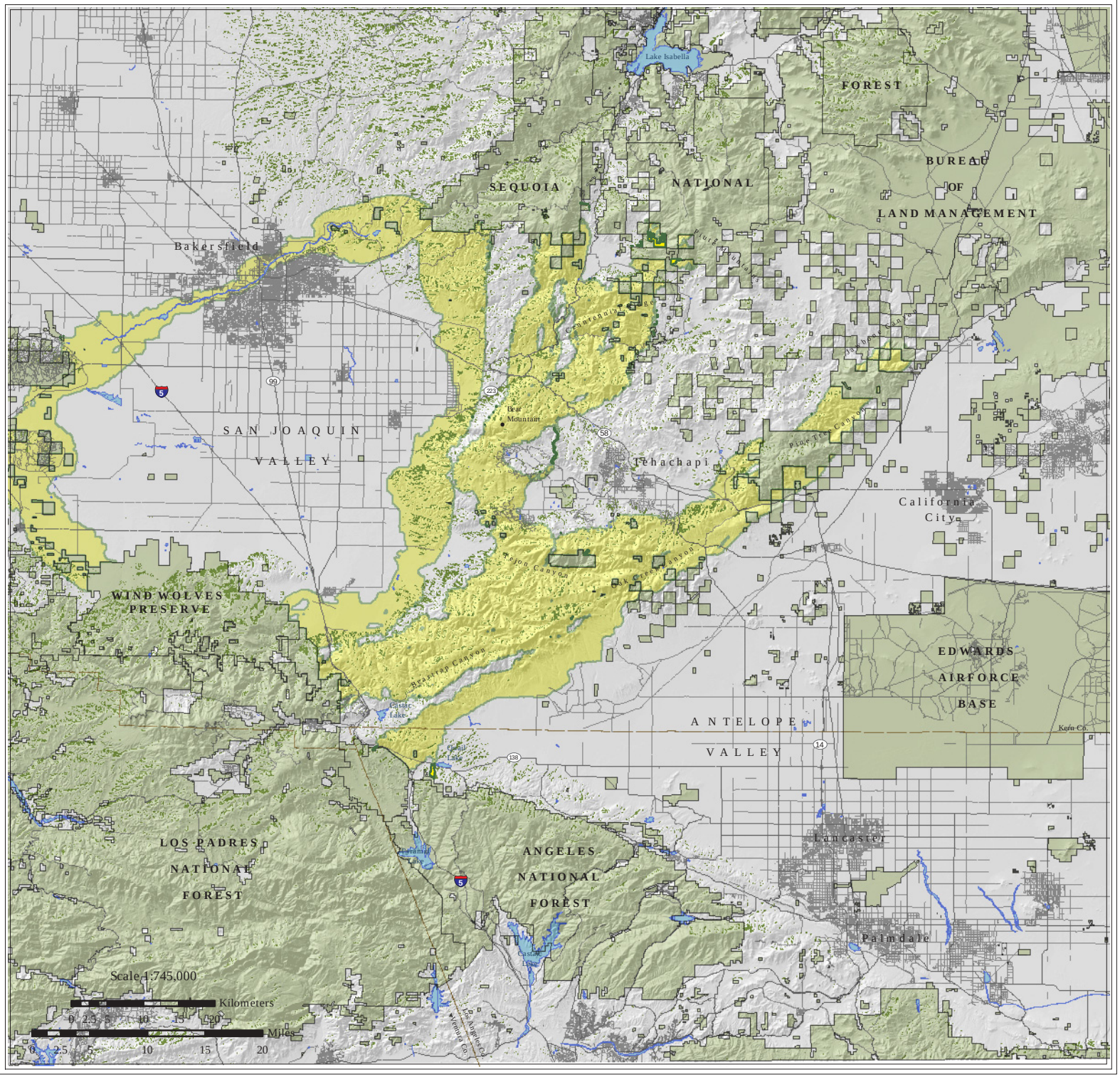
Results & Discussion: The linkages appear to be sufficient for their persistence, provided that major breaks in natural habitat do not occur (Figure 56). It is likely that this species can persist locally in relatively small habitat patches, provided that the linkage is "tight" enough to provide regular gene exchange between patches. The distribution appears to be relictual, probably around ancient shoreline gradients, and more recently fragmented by land use changes (grazing, fire frequencies, introduction of non-native grasses, etc.). It is unlikely that this species would persist through substrate or habitat disturbance, except that which models natural phenomena (F. Hovore, pers. comm.).

Figure 56.
Potential Cores for
Lined Lomatium longhorned borer
(Brachysomida vittigera)



Legend

- Least Cost Union
- Potential Cores
- Paved Roads
- Ownership Boundaries
- County Lines

N

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White Fir (*Abies concolor*)

Justification for Selection: Barriers to animal movement may hinder the dispersal abilities of this species (H. Safford pers. comm.).

Distribution & Status: The species reaches its best development and maximum size in the central Sierra Nevada (American Forestry Association 1978 *in* Laacke 1992). Elevations range from a minimum of 600 m (1,970 ft) to a maximum of almost 3400 m (11,150 ft) east of the continental divide in central Colorado. In the Sierra Nevada it is primarily found at elevations between 1200 and 2100 m (3,900 and 6,900 ft). In the Tehachapi Mountains, it may be found on high ridges or in canyon bottoms, on protected north facing slopes and in deep canyon bottoms (Twisselman 1967). This species is not afforded any special status.

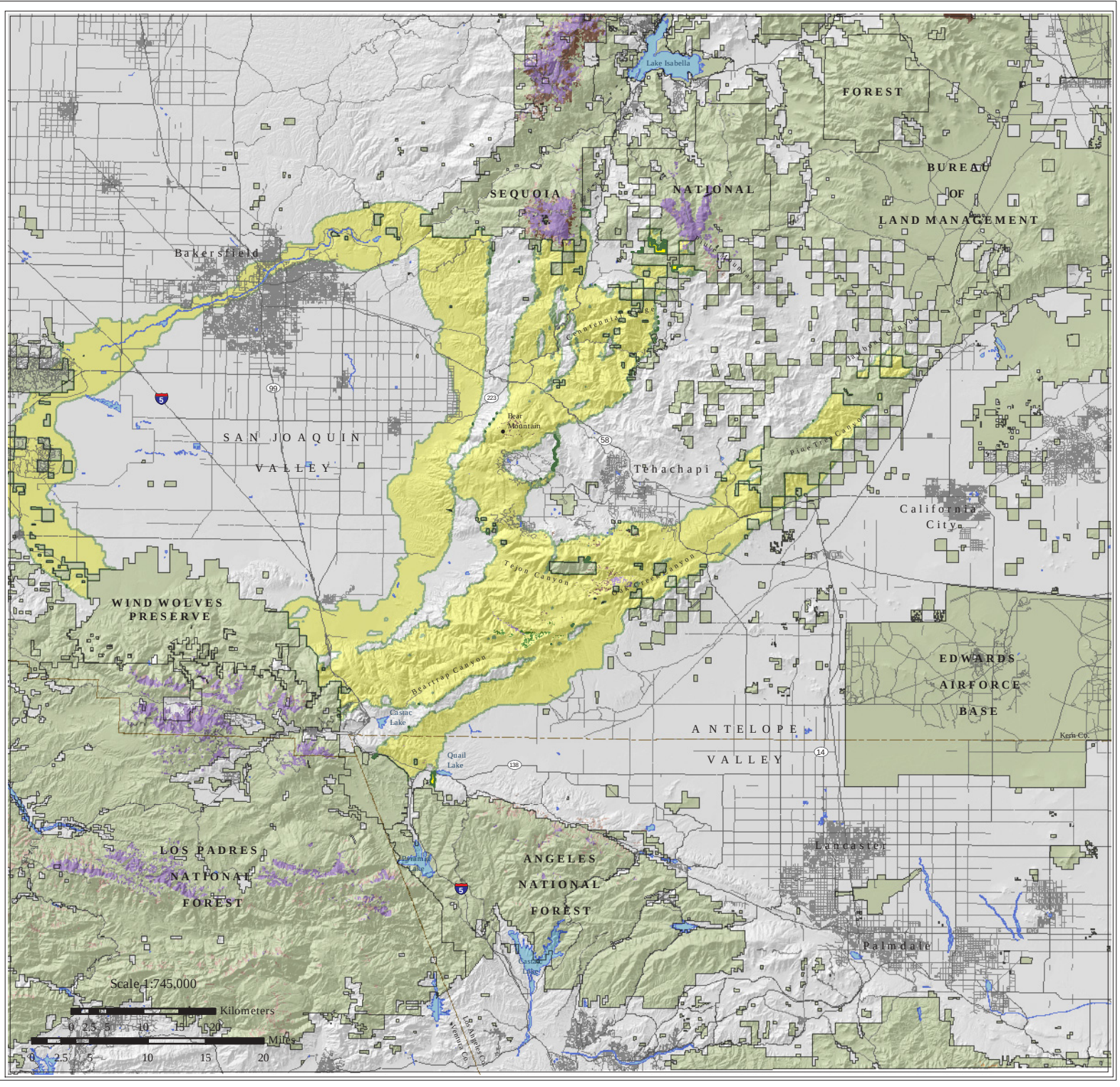
Habitat Associations: California white fir is a climax community. At higher elevations it may form pure stands. In the southern Sierra Nevada, white fir in this transition zone generally tolerates canopy closure better and dominates on nutrient-rich sites (Parker 1986 *in* Laacke 1992). The most common associates in mixed coniferous forests are incense-cedar, ponderosa pine, sugar pine, Jeffrey pine, Douglas-fir, and California black oak (Fowells 1965, Parker and Matyas 1980 *in* Laacke 1992). In the central Sierra Nevada, white fir is associated with giant sequoia (Fowells 1965 *in* Laacke 1992). In the Tehachapi Mountains, it is common in the Jeffrey pine forests.

Spatial Patterns: The species grows on various types of terrain, including extremely steep and unstable slopes, though it prefers gentle slopes and level ground. Seeds can lie dormant for up to 300 years, waiting to germinate in areas opened up by fire or harvesting where they may quickly establish dominance (Conard and Radosevich 1981, Fowells 1965, McNeil and Zobel 1980 *in* Laacke 1992). California white fir flowers in May or June, fertilization occurs soon after and seeds germinate in the spring immediately following snowmelt (Jones 1974 *in* Laacke 1992).

Habitat Suitability, Patch Size & Configuration Analyses: White fir is dispersed by birds, small mammals, and gravity ranging in distance from 1 m to 10 km (Safford pers. comm.). It is estimated that about 123 species of birds occur in the white fir habitats of California, 50 of which are associated primarily with mature forests. There are 33 species of mammals associated with White fir, with 7 of these dependent on mature stands. Reptiles are represented by 17 species, with 8 reliant on mature forests (Verner et al. 1980 *in* Laacke 1992). We did not attempt to model animal dispersers but instead identified potentially suitable habitat.

Results & Discussion: White fir currently has a limited distribution in the Tehachapi Mountains, while large populations of white fir exist in the Greenhorn Range of the Sequoia National Forest and in the Sierra Madre Range. Clusters of potentially suitable habitat were identified in upper Beartrap Canyon, and in Oak Creek Canyon within the Least Cost Union (Figure 57). White fir forests have been logged or degraded in parts of the Tehachapi Mountains, affecting habitat use and movements of blue grouse (*Dendragapus ocscurus*) between the Sierra Nevada and Sierra Madre ranges (J. Bland, pers. comm.).

Figure 57.
Potential Habitat for White fir
(Abies concolor)



Legend

- Least Cost Union
- Eastside pine
- Montane hardwood-conifer
- Ponderosa pine
- Sierran mixed conifer
- White fir
- Paved Roads
- Ownership Boundaries
- County Lines

N

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Blue oak (*Quercus douglasii*)

Justification for Selection: Continued clearing of blue oak for rangeland improvement resulted in the loss of 1 million acres (0.4 million ha) of blue oak woodland (Bolsinger 1988, U.S. Department of Agriculture 1959 *in* Howard 1992). Other factors contributing to species decline are road construction, residential, and commercial development (Vogl 1977 *in* Howard 1992). Use of blue oak for fuelwood is also an issue (Burns and Honkala 1990 *in* Howard 1992). Seedlings and young trees are uncommon in many regions due to the combination of drought cattle grazing, and the inability of very young seedlings to compete with nonnatives (Twisselman 1967).

Distribution & Status: Blue oak is a California endemic, which covers 8 percent of state's total land area (Adams et al. 1992, Barbour 1987 *in* Howard 1992). It occurs in valleys and lower slopes of the Coast Ranges and in lower foothills of the Sierra Nevada. Its distribution almost completely encircles the Central Valley (Holland 1986; Munz 1973). Blue oak ranges in elevation from 165 feet (50 m) at the northern Central Valley floor to 5,900 feet (1,800 m) in its southernmost distributional limits (Burns and Honkala, 1990 *in* Howard 1992). Blue oak is also found east of the crest of the mountains, especially in the canyons of the Tehachapi Range and the other desert-facing canyons north to Jawbone Canyon and the west side of Kelso Valley (Twisselman 1967). An extensive blue oak woodland exists in the Greenhorn foothills.

Habitat Associations: Blue oak is often found with gray pine but may also occur with several other oak species, including interior live and valley oaks. The blue oak can may form dense woodlands or occur on open savannas. It merges or forms a mosaic with annual grassland at low elevation and with chaparral, other oak woodland phases, or singleleaf pinyon-California juniper woodland at higher elevation (Griffin 1977 *in* Howard 1992). They may also be found in association with Coulter pine and California buckeye (Howard 1992). Soil substrates range from gravelly loam to gravelly clay-loam (Burns and Honkala 1990 *in* Howard 1992).

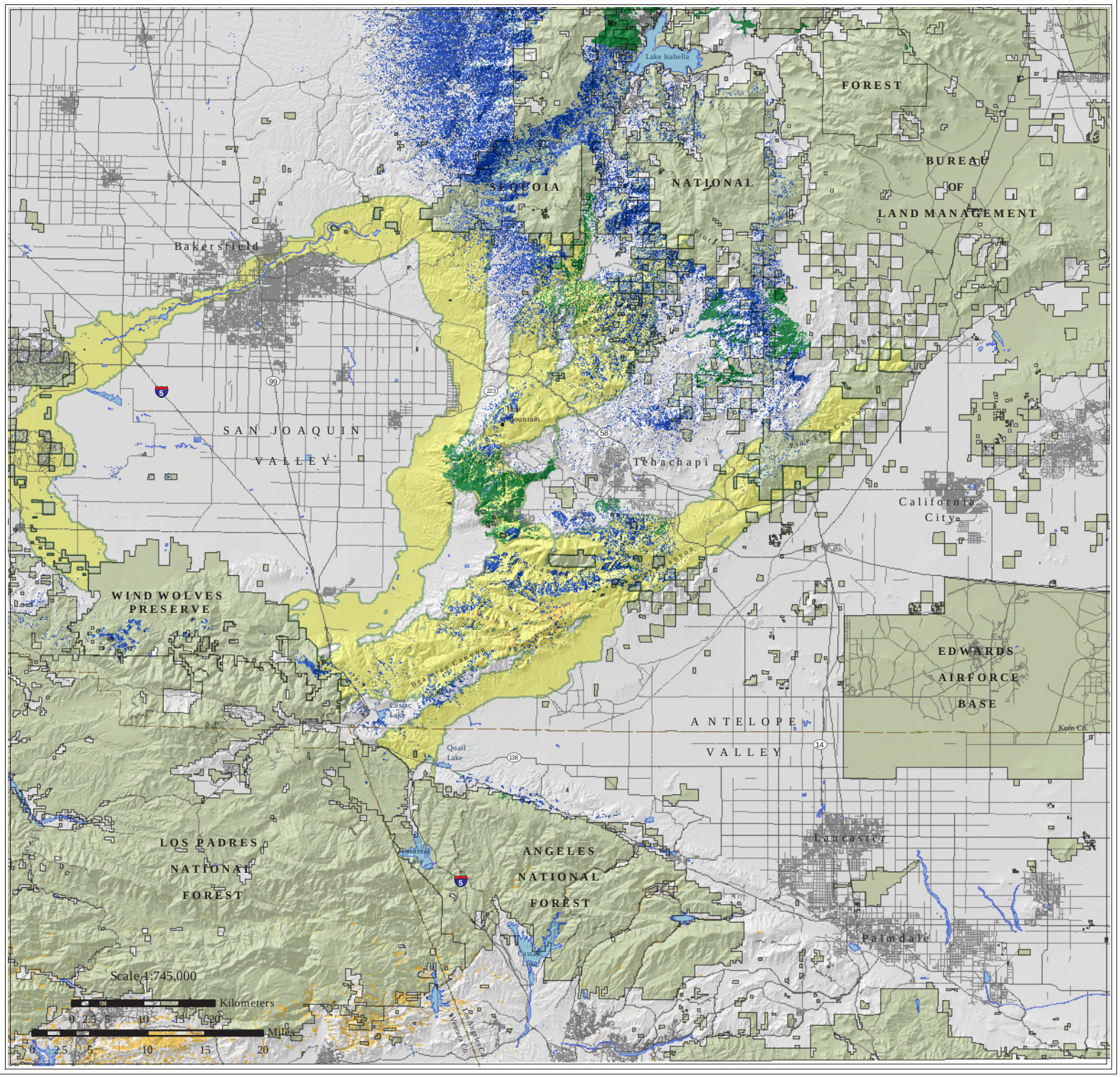
Spatial Patterns: Abundant acorn crops are produced every 2 to 3 years, with larger crops every 5 to 8 years (Olson 1974 *in* Howard 1992). The acorns are capable of immediate germination. A 3-year study in the central Sierra Nevada foothills showed that blue oak woodland is utilized by 92 species of birds, 7 species of rodents, 3 lizards, 4 snakes, and the state-endangered foothill yellow-legged frog (Block and Morrison 1987 *in* Howard 1992).

Conceptual Basis for Model Development: Vegetative communities in which the species is likely to occur (i.e., blue oak woodland and blue oak foothill pine) were queried in a GIS to evaluate general distribution and potential suitable habitat.

Results & Discussion: This species appears to be well represented in the Least Cost Union (Figure 58), and represents roughly 40% of the oak diversity in the final Linkage Design. The Blue oak woodland community is seriously underrepresented in existing protected areas, 75% is in private ownership, 14% is in the National Forest System, and 11% is in various other public ownerships (Bolsinger 1988 *in* Howard 1992). This is clearly a species that needs the linkage and it provides valuable foraging and nesting habitat for a variety of wildlife species.

Figure 58.
Potential Habitat for
Blue oak

(Quercus douglasii)



Legend

- Least Cost Union
- Blue Oak-Foothill Pine
- Blue Oak Woodland
- Coastal Oak Woodland
- Paved Roads
- Ownership Boundaries
- County Lines

N

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California Black Oak (*Quercus kelloggii*)

Justification for Selection: Oaks (Quercus spp.) may be the single most important genus used by wildlife for food and cover in California forests and rangelands (Edelbrock 1991 *in* Howard 1992), and California black oak occupies more total area in California than any other hardwood species (Bolsinger 1988 *in* Howard 1992).

Distribution & Status: California black oak is distributed along foothills and lower mountains of California and southern Oregon. It is found from Lane County, Oregon south through the Cascade Range, the Sierra Nevada, and the Coast, Transverse, and Peninsular ranges to San Diego County, California (Munz 1973). California black oak can live up to 500 years of age (Burns and Honkala 1990 *in* Howard 1992. In California, the elevational range varies from 200 to 8,000 feet (60-2,440 m) (Burns and Honkala 1990 *in* Howard 1992).

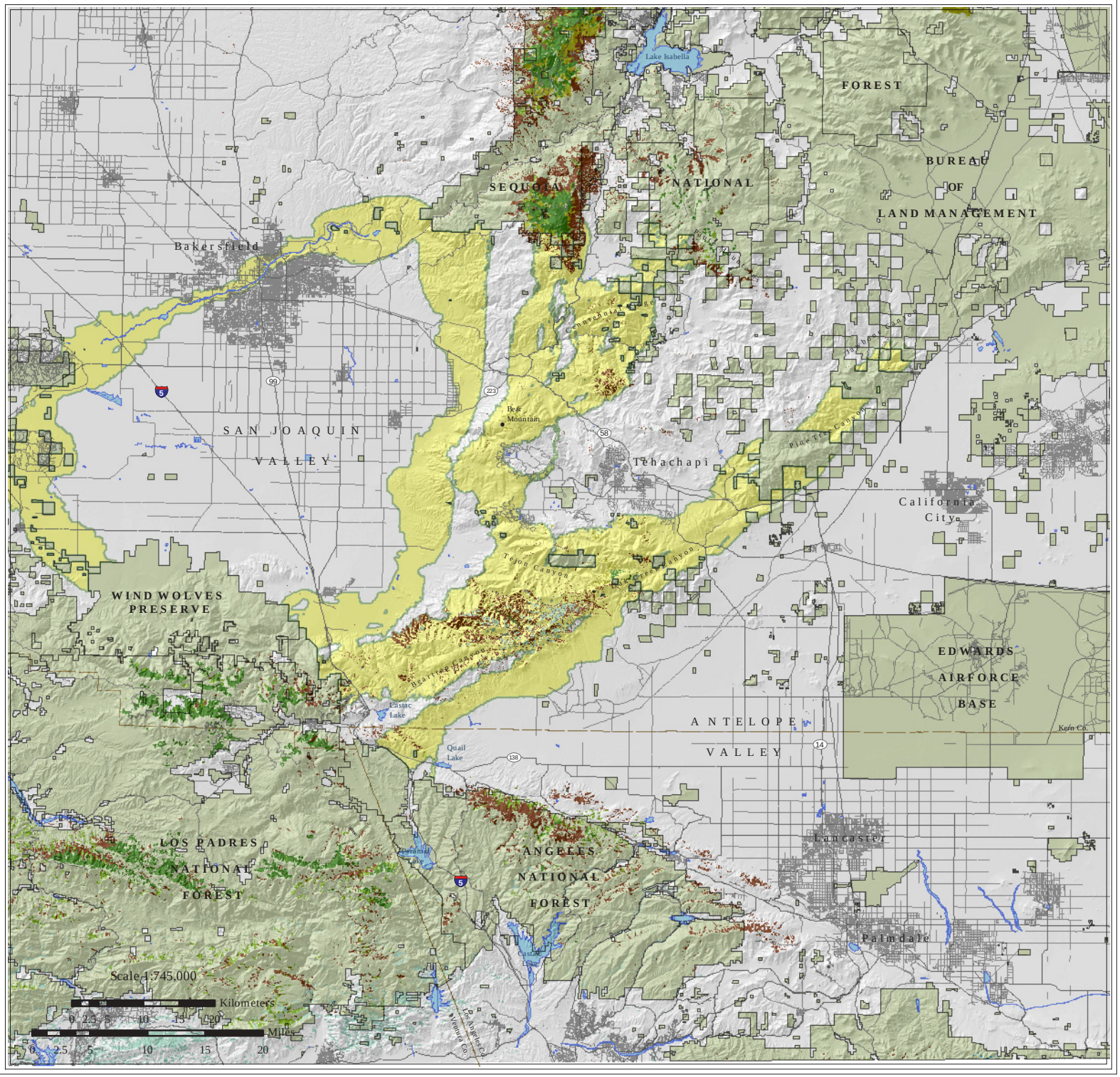
Habitat Associations: California black oak occurs in pure or mixed coniferous forest stands (Twisselman 1967). Commonly associated species include incense-cedar, tanoak, interior live oak, Pacific dogwood, and bigleaf maple (Burns and Honkala 1990 *in* Howard 1992). Common understory shrubs include various species of manzanita, Brewer oak, Sierra gooseberry, poison-oak, and Sierra mountain misery (Burns and Honkala 1990 *in* Howard 1992).

Spatial Patterns: California black oak is wind pollinated. Acorns may be dispersed by by gravity or animals (Burns and Honkala 1990 *in* Howard 1992). Acorn viability varies greatly. Seedling establishment rates are best in acorns buried by seed-caching rodents or birds. The California ground squirrel and the Stellar's jay are important for seed dispersal. Seedlings cannot establish on heavy clay soils or soils compacted by logging (Howard 1992).

Conceptual Basis for Model Development: Vegetative communities in which the species is likely to occur (i.e., montane hardwood, mixed coniferous forests) were queried in a GIS to evaluate general distribution and potential suitable habitat.

Results: California black oak appears to be well represented in the Least Cost Union (Figure 59). It has a similar distribution to blue oak in the linkage, mainly in the middle prong of the Linkage Design. It also occurs on the northern slopes of the San Gabriel, in the Sierra Madre and Sierra Nevada ranges.

Figure 59.
Potential Habitat for California black oak
(Quercus kelloggii)



Legend

- Least Cost Union
- Coastal oak woodland
- Eastside pine
- Montane hardwood-conifer
- Montane hardwood
- Ponderosa pine
- Sierran mixed conifer
- Paved Roads
- Ownership Boundaries
- County Lines

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California Buckeye (*Aesculus californica*)

Justification for Selection: California buckeye is valuable for habitat restoration of stream or riverbanks and on steep slopes (Goldner 1984, Katibah 1984, Stromberg and Katibah 1984 *in* Howard 1992). The species ability to disperse can be hindered by barriers to animal dispersal and lack of appropriate habitat to germinate and survival of plants (H. Safford, pers. comm.).

Distribution & Status: California buckeye is an endemic plant of California. It occurs in the Klamath and Coast Ranges from Siskiyou County south to Los Angeles County. In the Cascade Range and the foothills of the Sierra Nevada, it occurs from Shasta County south to Kern County. California buckeye is occasionally found in the Central Valley in Yolo, Colusa, and Stanislaus Counties (Holmer et al 1994 *in* Howard 1992). California buckeye occurs below 4,000 feet (1,219 m) (Munz 1973).

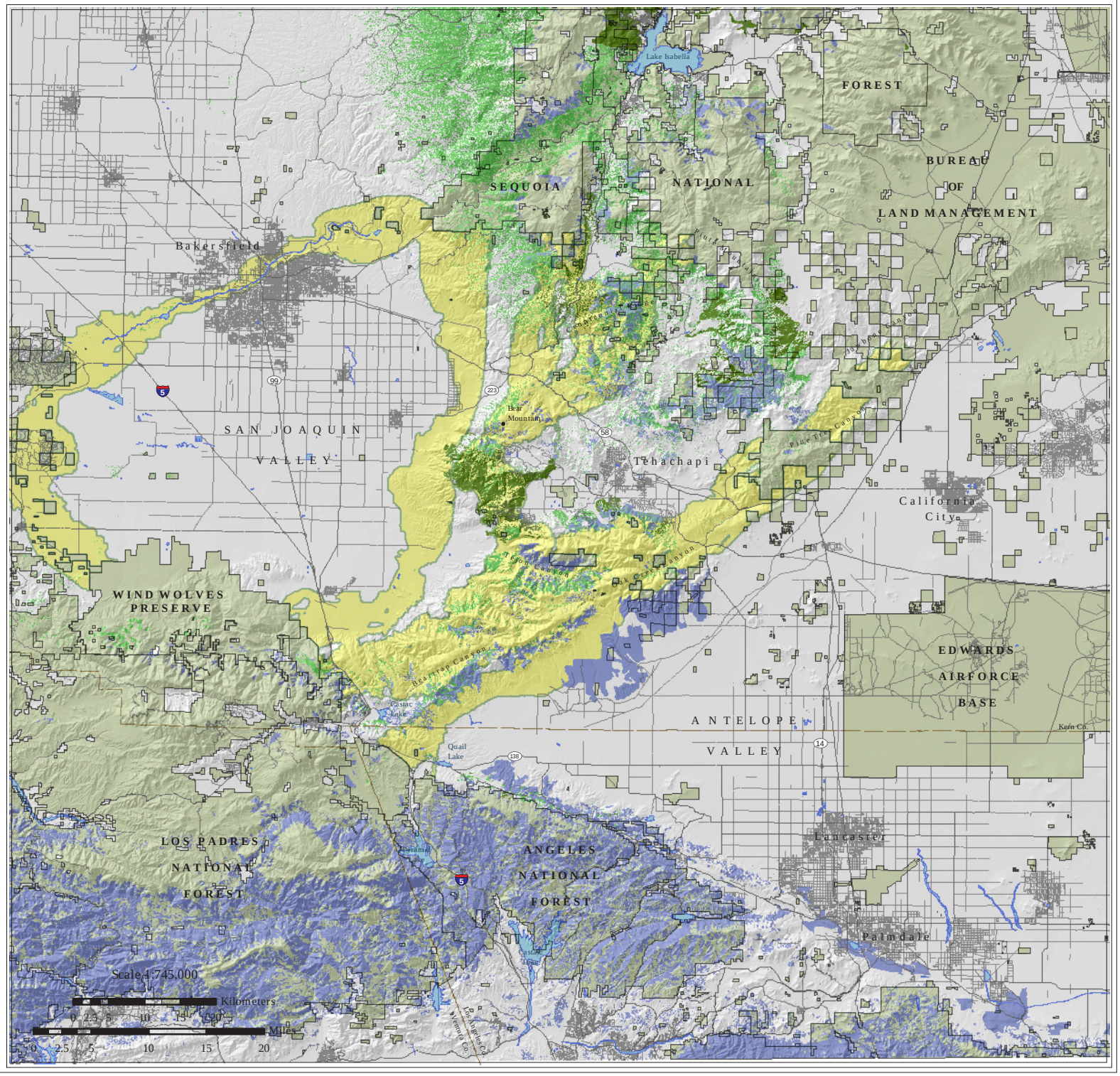
Habitat Associations: California buckeye grows on dry slopes, in canyons, and along waterways (Munz 1973). In the Central Valley it occurs along stream and riverbanks (Holmer et al 1994, Mirov and Kraebel 1937 *in* Howard 1992). It occurs as widely scattered individuals in open grasslands. It also occurs as an understory shrub in mixed evergreen forest (Baker et al. 1981 *in* Howard 1992). California buckeye occurs below 4,000 feet (1,219 m) (Munz 1973). It is an indicator species of climax chaparral and mixed oak communities (Allen et al. 1991 *in* Howard 1992) and in California buckeye woodlands (Buckman 1964 *in* Howard 1992). California Buckeye will move up the slopes with warming (H. Safford, pers. comm.). California buckeye is generally common in the mountains southwest to Lebec where it can form a mixed woodland with Douglas oak and digger pine. It is most commonly found in Kern Canyon on the steep canyon sides while being rather rare in Pleito Canyon of the Emigdio Range (Twisselman 1967). Its distribution is very common on North facing slopes (H. Safford, pers. comm.).

Spatial Patterns: Seed dispersal is poor and is accomplished mainly by gravity or water; dispersal by animals is rare (Halverson and Clark 1989 *in* Howard 1992). California buckeye can sprout from the stump or root crown (Baker et al. 1982, Van Dersal 1938 *in* Howard 1992). The dispersal of seeds ranges from meters to hundreds of meters (H. Safford, pers. comm.).

Conceptual Basis for Model Development: Vegetative communities in which the species is likely to occur (i.e., chaparral, mixed oak woodlands and coniferous forests) were queried in a GIS to evaluate general distribution and potential suitable habitat.

Results: This species also appears to be addressed by the Least Cost Union (Figure 60). It is primarily distributed in Beartrap and Tejon canyons in the middle and eastern prongs of the Linkage Design. California buckeye will also benefit from chaparral habitat added to the Least Cost Union.

Figure 60.
Potential Habitat for California buckeye
(Aesculus californica)



Legend

- Least Cost Union
- Paved Roads
- Ownership Boundaries
- County Lines
- Blue oak-Foothill pine
- Blue oak woodland
- Mixed chaparral

N

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Jeffrey Pine (*Pinus jeffreyi)*

Justification for Selection: Jeffrey pine is an important tree for providing wildlife cover and food resources (Evans 1988 *in* Habeck 1992).

Distribution & Status: Jeffrey pine is distributed from the Klamath Mountains into southwestern Oregon, across the Sierra Nevada into western Nevada, and south to the Transverse and Peninsular Ranges and into northern Baja California (Haller 1962, Jenkinson 1990 *in* Habeck 1992). Jeffrey pine is the dominant tree at the higher levels of the yellow pine forest, especially along ridgetops and other exposed places in the Greenhorn Range and on Breckenridge Mountain, occurring mostly over 6,000 feet elevation. It basically replaces the ponderosa pine at all altitudes on the Kern Plateau, in the Piute and Tehachapi Mountains, and in the Mt. Pinos region. Important to the Jeffrey pines distribution is even more its high tolerance of cold and than its great drought resistance (Twisselman 1967). An isolated colony of trees of all ages can be found at the western end of the Tehachapi Mountains east of Keene. It also occurs on the steep north slopes at the head of desert-facing Pine Tree Canyon (Twisselman 1967).

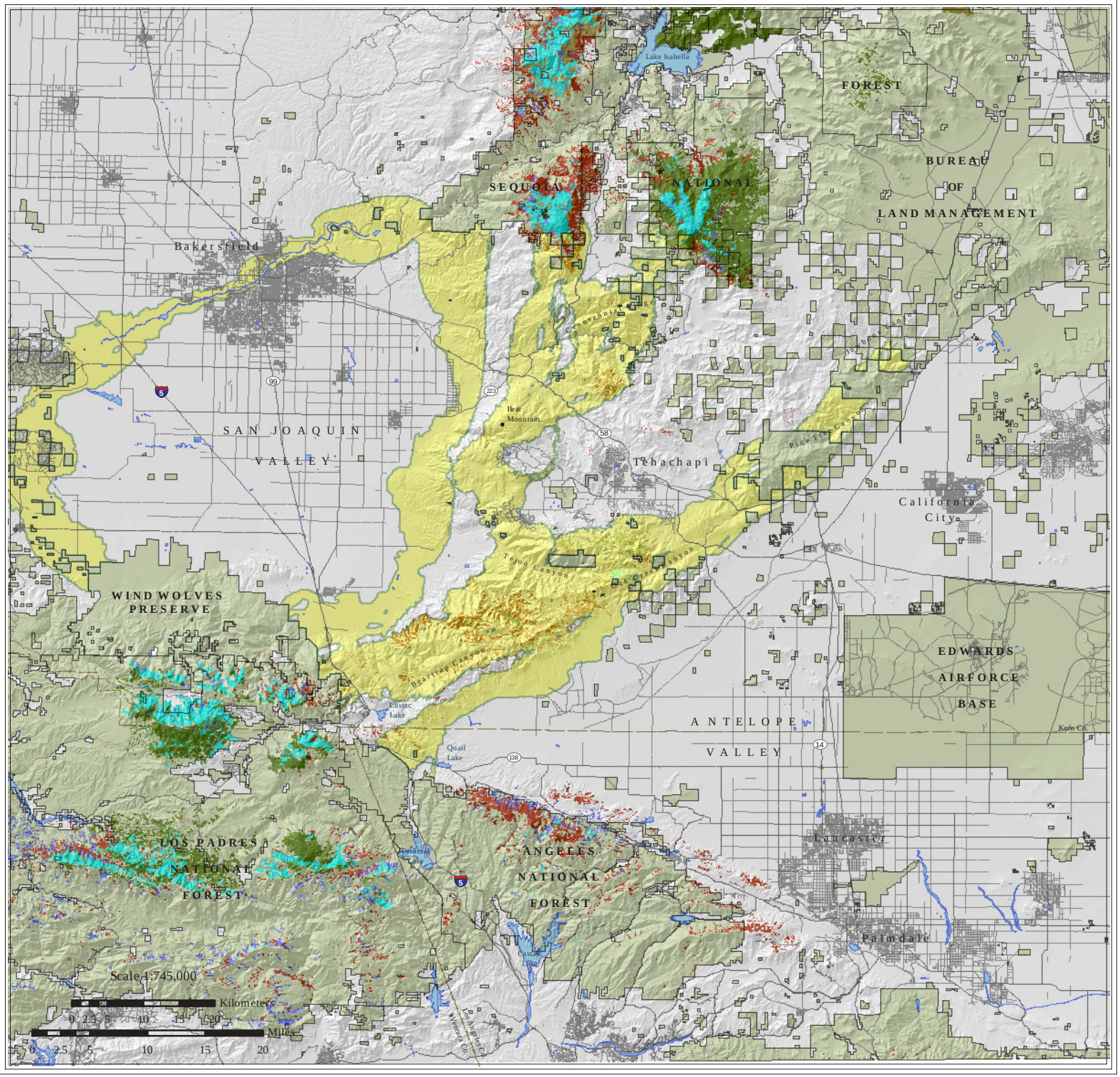
Habitat Associations: Jeffrey pine occupies many sites from the edges of moist high montane meadows to arid slopes bordering deserts. It generally occurs on the drier or higher elevations. It forms pure stands along the eastern slope of the Sierra Nevada. It grows in mixed stands with ponderosa pine, incense cedar, white fir, and juniper (Habeck 1992). Jeffrey pine overlaps extensively with ponderosa pine and sugar pine on the western slopes of the Sierra Nevada, California.

Spatial Patterns: Factors relating to poor seed dispersal seem to be the major limiting factor in the natural succession of Jeffrey pine (Heath 1967 *in* Habeck 1992). Heavy winds may disperse seeds up to 2,460 feet (750 m) from a tree height of 164 feet (50 m). Wildlife also aid in seed dispersal. Vander Wall (1992) found dissemination patterns of Jeffrey pine linked extensively to animal hoarding of seeds in shallow surface caches (*in* Habeck 1992). Small mammals such as the western gray squirrel harvest and store the seeds (Fowells and Stark 1965, Jenkinson 1990, Krugman and Jenkinson 1974, Temple 1988 *in* Habeck 1992).

Conceptual Basis for Model Development: Vegetative communities in which the species is likely to occur (i.e., montane hardwood and coniferous forests, Jeffrey, Eastside, and Ponderosa pine) were queried in a GIS to evaluate general distribution and potential suitable habitat.

Results: Jeffrey pine is occurs throughout the central portion of the Tehachapi Mountains, with a distribution resembling that of the 2 oak species, with larger populations in the Sierra Madre and Sierra Nevada cores areas (Figure 61). The species appears to be accommodated by the Least Cost Union.

Figure 61.
Potential Habitat for Jeffrey pine
(Pinus jeffreyi)



Legend

- Least Cost Union
- Eastside pine
- Jeffrey pine
- Montane hardwood-conifer
- Montane hardwood
- Ponderosa pine
- Sierran mixed conifer
- Paved Roads
- Ownership Boundaries
- County Lines

N

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Singleleaf Pinyon Pine (*Pinus monophylla*)

Justification for Selection: Provides important food resources for various wildlife species.

Distribution & Status: Pinyon-juniper woodlands cover more than 55.6 million acres in the western United States. It is the predominant tree species in the isolated mountain ranges of the Great Basin, ranging from southern Idaho, western Utah and northwestern Arizona, through most of Nevada (it's Nevada's state tree) and eastern and central California to northern Baja California (Zouhar 2001). The common singleleaf pinyon often forms distinct woodlands and can be found on the desert slopes of the mountains west to the Piute Mountains and the east slope of the Greenhorn Range southwest to the east end of Cuyama Valley. It also occurs on ridgetops along the mountains bordering the desert in the Jawbone Canyon. Singleleaf pinyon can also be found growing in conjunction with digger pine on the east slope of the Piute Mountains, the southern Kern Plateau and at the head of Tejon Canyon (Twisselman, 1967). Pinyon/juniper woodland is found up to 2800 m in elevation (Hickman 1993 *in* Zouhar 2001).

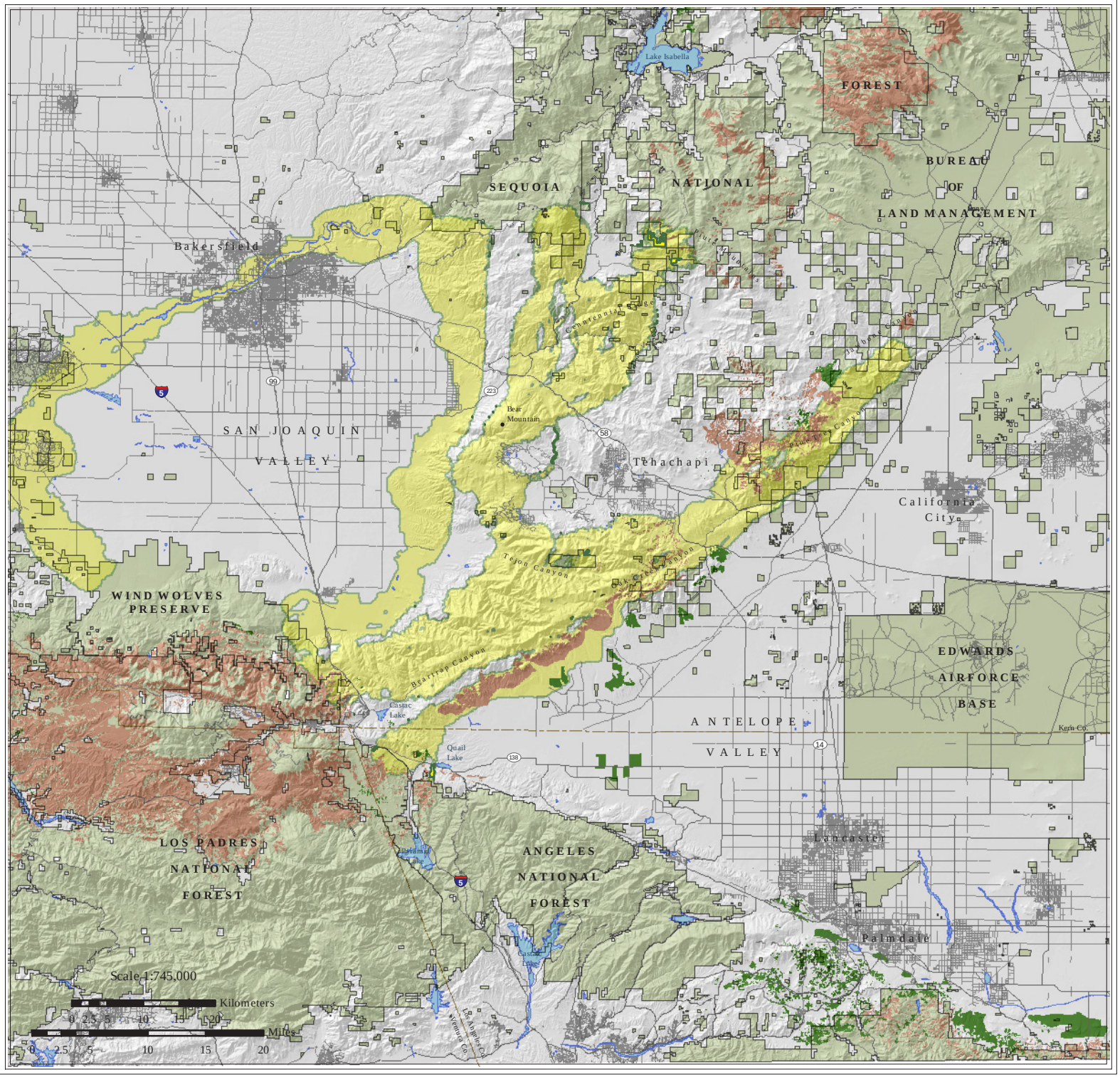
Habitat Associations: Pinyons (*Cembroides*) typically grow in association with juniper (*Juniperus* spp.), with juniper dominating the lower elevations of their range and pinyons the upper. On the eastern slopes of the Sierra Nevada singleleaf pinyon is found with western juniper, Jeffrey pine, ponderosa pine, big sagebrush, curlleaf mountain-mahogany, and rabbitbrush scrub (Zouhar 2001). They may also be found in associations with bigcone Douglas-fir at upper elevations in southern California (Zouhar 2001). In southern California, singleleaf pinyon is a common component of the desert montane landscape on arid slopes and is most commonly found with California juniper (Zouhar 2001).

Spatial Patterns: Home range can be feet to miles. The dispersal distance is very small and it has to rely on mammals and birds. Wind is needed for pollination. (I. Anderson pers. comm.).

Conceptual Basis for Model Development: Vegetative communities in which the species is likely to occur (i.e., desert scrub and woodlands) were queried in a GIS to evaluate general distribution and potential suitable habitat.

Results: This species appears to be well represented in the Least Cost Union (Figure 62). It has the potential to occur along the southeastern slopes of the Tehachapi Mountains and in the Pine Tree, Oak Creek, and Jawbone canyon areas within the Least Cost Union. Larger populations occur in the two core areas.

Figure 62.
Potential Habitat for
Single-leaf pinyon pine
(Pinus monophylla)



Legend

- Least Cost Union
- Juniper
- Pinyon - juniper
- Paved Roads
- Ownership Boundaries
- County Lines

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Bakersfield cactus (*Opuntia basilaris* var. *treleasei*)

Justification for Selection: Bakersfield cactus is threatened by the conversion and degradation of its habitat due to urbanization, agriculture, oil field development, overgrazing, off-road vehicles, sand mining, competition from non-native grasslands, and anything that blocks streams (USFWS 1998, CDFG 2000, E. Cypher pers. comm.).

Distribution & Status: This endemic species is now restricted to the mesas east of Bakersfield to Comanche Point in Kern County, though it once formed extensive colonies from the Kern River to Caliente Wash (Twisselman 1967, CDFG 1995, CDFG 2000). The first specimen was recorded at "Caliente, in the Tehachapi Mountains" (Coulter 1896 *in* USFWS 1998). By 1987 it was limited to 4 general locales, Granite Station, Comanche Point, Caliente, and Oildale (CDFG 1995 *in* USFWS 1998). In 1989, the species was recorded as extant at the following locations: Caliente Creek, Comanche Point, Cottonwood Creek, Fairfax Rod-Highway 78 Highway 184, Kern Bluffs-Hart Park, Fuller Acres, Granite Station, mouth of Kern Canyon, Oildale, Poso Creek, Sand Ridge, and Wheeler Ridge in the Plieto Hills (CDFG 1995, Moe 1989 *in* USFWS 1998). When last inventoried, fewer than 20,000 clumps remained, only 4 areas (Comanche Point, Kern Bluff, Wheeler Ridge and Sand Ridge) with 1,000 clumps or more: (CDFG 1995, Moe 1989, R. van de Hoek pers. Comm. *in* USFWS 1998). The species is federally and state listed as endangered.

Habitat Association: Bakersfield cactus prefers sandy or gravelly substrates in chenopod scrub, valley and foothill grasslands, and cismontane woodlands, between 120-550 m in elevation (CDFG 2000, CNPS 2001). They may also occur in is the sandy soils of washes and ridges or streams, where they are often associated with *Lepidospartum squamatum* (E. Cypher pers. comm.). The highest elevation record was at Caliente (550 m), while the lowest was documented at Fuller Acres (121 m) (CDFG 1995 *in* USFWS 1998). However, historical records indicate that this species was most commonly found between 140 to 260 m (USFWS 1998).

Spatial Patterns: Cactus populations are typically recorded by the number of clumps rather than by individuals. Clumps of Bakersfield cactus are known to grow up to 35 cm (14 in) high and 10 m (33 feet) across (R. van de Hoek pers. comm. *in* USFWS 1998). In 1967, Twisselman estimated the colony at Caliente Wash and Sand Ridge to be approximately 4 miles long and up to a ½ mile across.

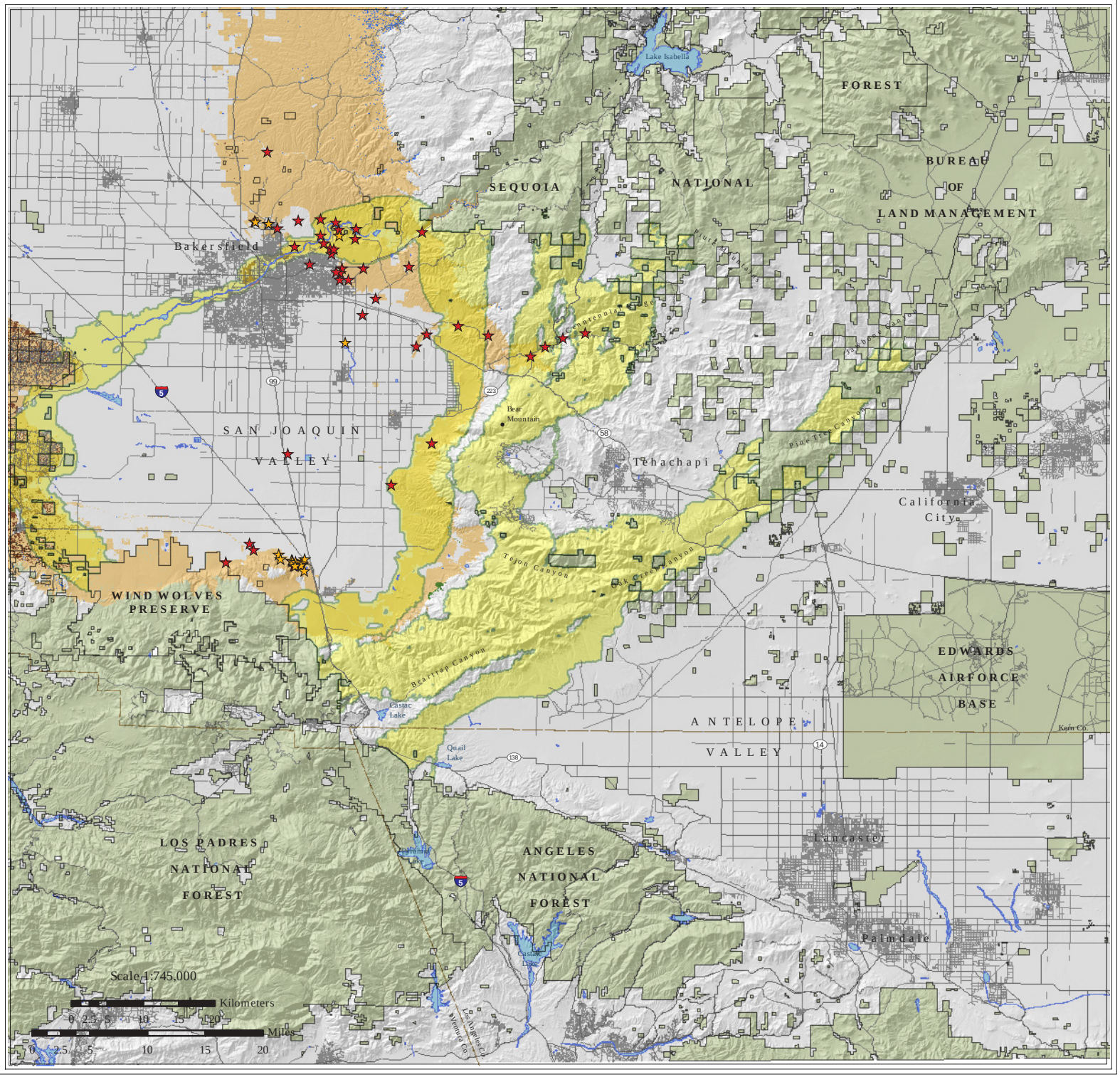
No studies have been conducted on the reproductive biology of this species, but other Opuntia species require cross-pollination for seed set and many are pollinated by bees (Benson 1982, Spears 1987, Osborn et al. 1988 *in* USFWS 1998). A potential pollinator of Bakersfield cactus is the native solitary bee *Diadasia australis* ssp. *californica*, which specializes in collecting pollen from Opuntia species (Thorp in litt. 1998 *in* USFWS 1998). Animals may occasionally aid in seed dispersal (E. Cypher pers. comm.). The flowing water of streams and rivers may also provide dispersal opportunities for this species whose pads may detach, flow down stream and vegetatively reproduce (E. Cypher pers. comm.).

Conceptual Basis for Model Development: Bakersfield cactus is associated with the grasslands that rim the valley, but it also occurs into the foothills and mountains in

grassland, chenopod scrub, and cismontane woodlands. They may also occupy habitat along washes, rivers, or streams. The elevational range for this species is 120-550 m.

Results & Discussion: The habitat suitability output corresponds nicely to the recorded occurrences for this species (Figure 63). The majority of potentially suitable habitat included in the Least Cost Union is comprised of annual grassland, though patches of alkali desert scrub, blue oak-foothill pine, blue oak woodland, perennial grassland, and valley oak woodland may also provide appropriate habitat within the elevational range of the species. A large portion of the habitat identified for this species that occurs between protected lands in the planning area was captured in the Least Cost Union, including the grassland habitat that rims the valley floor from Wind Wolves Preserve to the southwestern boundary of Sequoia National Forest. This area was also identified as a linkage zone for this species in the recovery plan (Recovery Task 5.3.8) for upland species of the San Joaquin Valley (USFWS 1998). Other areas captured in the Least Cost Union include the grassland and alkali scrub communities between Wind Wolves and Elk Hills and habitat along the upper Kern River near Bakersfield. Other potentially key areas not incorporated into the Least Cost Union include habitat on Wheeler Ridge, in Tejon Canyon, south of the Kern River just east of Bakersfield, and in the Sierra foothills to the north. This species may also benefit from habitat added to the Least Cost Union.

Figure 63.
Potential Habitat for
Bakersfield cactus
(Opuntia basilaris* var. *treleasel)



Legend

- Least Cost Union
- Annual grassland
- Alkali desert scrub
- Blue oak-foothill pine
- Blue oak woodland
- Perennial grassland
- Valley oak woodland
- SERP Occurences*
- CNDDB observation
- Paved Roads
- Ownership Boundaries
- County Lines

*Data courtesy of CSUS Endangered Species Recovery Program, 1998.

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Tejon poppy (*Eschscholzia lemmonii* ssp. *kernensis*)

Justification for Selection: This species was selected as an indicator for the valley floor grassland community. It is sensitive to habitat loss and fragmentation from urban and agricultural developments. Non-native plants also inhibit seed germination (E. Cypher pers. comm.).

Distribution & Status: Tejon poppy is an endemic restricted to Kern County. The species was first described from a specimen collected from the "Tejon Hills, 2 miles northwest of Tejon Ranch headquarters, Kern County" (Munz 1958 *in* USFWS 1998). The species has been recorded from 6 areas in the grassland habitats that surround the southern tip of the San Joaquin Valley. Twisselman recorded this species in the Tejon Hills between Chanac and Tejon Canyons (1967). The recovery plan (USFWS 1998) described recorded occurrences on Dry Bog Knoll in Adobe Canyon, on the mesas east of Bakersfield, at Comanche Point (Twisselmann 1967), in the Elk and Pleito Hills (CDFG 1995), and near Maricopa (CNPS 2001). The only known extant population is at Elk Hills; all other populations are on private land and have not been surveyed in over 3 decades (USFWS 1998).

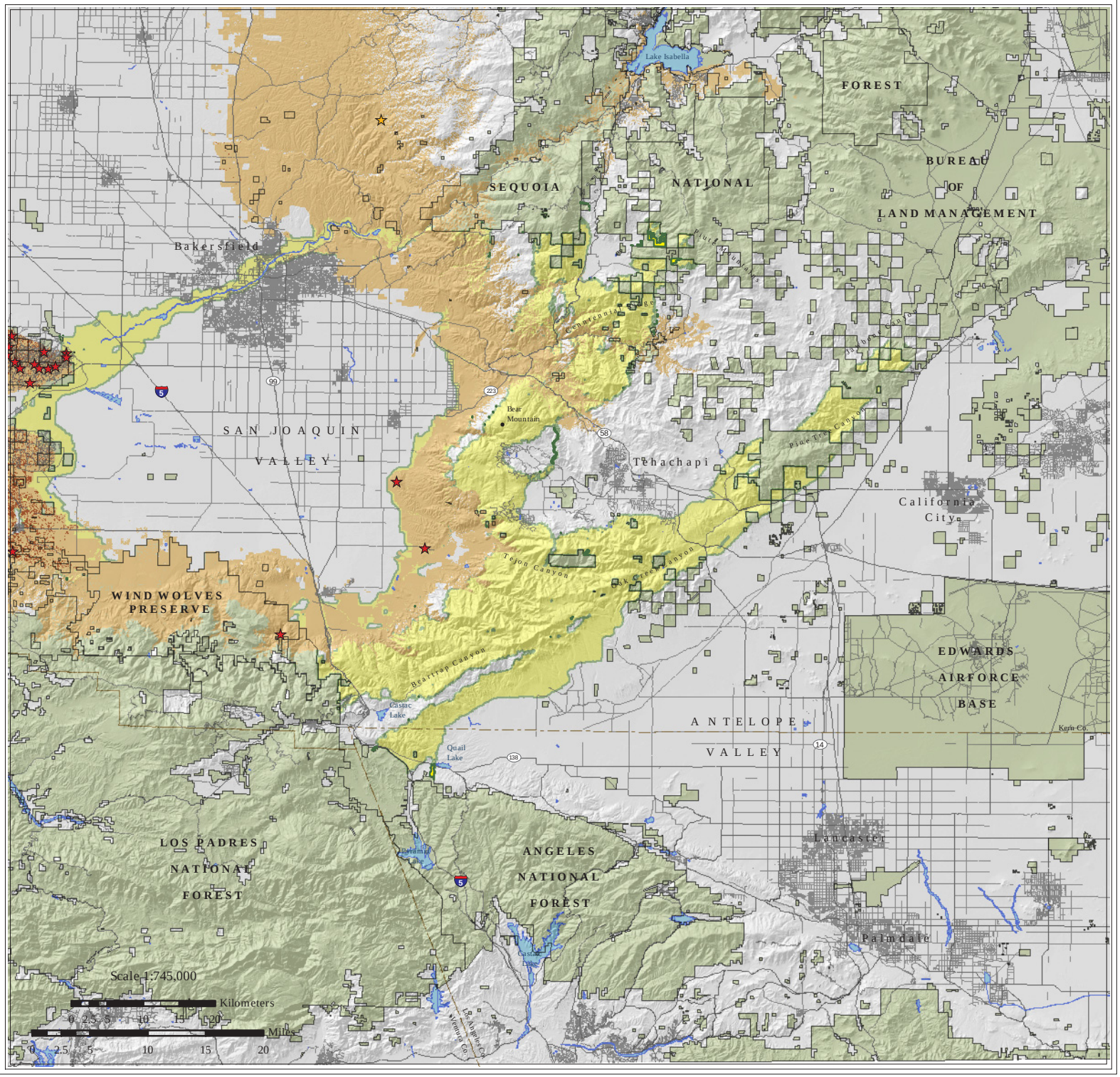
Habitat Associations: It prefers clay soils in open grasslands between 250-600 m in elevation (Twisselmann 1967, CDFG 1995). At Comanche Point, the species was found in association with Kern brodiaea, sunset lupine, and Comanche point layia (Twisselman 1969 *in* USFWS 1998).

Spatial Patterns: This species is associated with grassland habitat on the slopes above the valley floor (E. Cypher pers. comm.) and may be quite conspicuous in years with abundant rainfall (Twisselman 1967). Wind and possibly rodents may assist in seed dispersal (E. Cypher pers. comm.).

Conceptual Basis for Model Development: This species may be associated with open grassland or alkali scrub communities between 250-600 m in elevation. Vegetative communities in which the species is likely to occur were queried in a GIS to evaluate general distribution and potential suitable habitat.

Results & Discussion: The habitat suitability output also corresponds nicely to the recorded occurrences for this species (Figure 64). A large portion of the habitat identified for this species was captured in the Least Cost Union, including the grassland habitats along the arc of the valley floor. Other potentially key areas not captured in the Least Cost Union include habitats on Wheeler Ridge, in Tejon Canyon, south of the Kern River just east of Bakersfield, and in the Sierra foothills to the north. This species may also benefit from the additional habitat included in the Linkage Design.

Figure 64.
Potential Habitat for
Tejon poppy
(Eschscholzia lemmonii kernensis)



Legend

- Least Cost Union
- Annual grassland
- Alkali desert scrub
- SERP Occurences*
- CNDDB Observations
- Paved Roads
- Ownership Boundaries
- County Lines

*Data courtesy of CSUS Endangered Species Recovery Program, 1998.

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