Burro Deer (*Odocoileus hemionus eremicus*)

Legal Status

State: None
Federal: None
Critical Habitat: N/A
Recovery Planning: N/A

Taxonomy

The burro deer (*Odocoileus hemionus eremicus*) is the desert dwelling subspecies of the widespread mule deer (*Odocoileus hemionus*). The burro deer was first described by Mearns in 1897 from a specimen taken near the Gulf of California in Sonora, Mexico. Longhurst and Chatting (as cited in Celentano and Garcia 1984) reported that burro deer are distinguished from other subspecies on the basis of cranial measurements, external body measurements, and coloration. Since 1997, desert mule deer (*O. h. crooki*) and burro deer (*O. h. eremicus*) have been synonymized (*O. h. eremicus*) (Heffelfinger 2006). As a result, the overall area identified as containing this subspecies now encompasses much of the southwestern United States and northern Mexico, including southeastern California (Marshal et al. 2004).

Distribution

General

Mule deer are widespread across most of the western United States, western Canada, and south into northern Mexico. The burro deer subspecies is native to the Mojave and Sonoran deserts of the southwestern United States and northern Mexico. Within California, the burro deer is found in the eastern portions of Imperial and Riverside counties, and as far north as the southeastern corner of San Bernardino County. From the Colorado River they range west into California along vegetated washes to the Coxcomb Mountains, Palen Mountains, Little San Bernardino Mountains, Chuckwalla Mountains,

Chocolate Mountains, and formerly through the Imperial Valley to Indio. Burro deer are predominately associated with major river corridors and dry desert washes leading down to the Colorado River and other major rivers. In the hottest months deer are found close to permanent water and forage sources such as the Colorado River. However, with the onset of the summer monsoons in early August and September, burro deer may disperse to the desert mountains (Celentano and Garcia 1984).

Distribution and Occurrences within the Plan Area

Historical

The distribution of burro deer within California was described as far back as 1936 and appears to reflect their current distribution, though it is thought that their former range extended northwest through the Imperial Valley to Indio, and may once have extended around the west side of the Salton Sea (Celentano and Garcia 1984). Much of the area west of Salton Sea and north to Indio was converted to agriculture several decades ago. No pre-1990 occurrences are recorded within the California Natural Diversity Database (CNDDB); however, annual harvest population estimates indicate that the burro deer population fluctuated between 2,000 and 5,000 individuals between 1940 and 1990 (Celentano and Garcia 1984; CDFG 1997, 2007).

Recent

There is no evidence to suggest that burro deer distribution differs from historical (pre-1990) distribution described above. Because burro deer is not a state special-status species, it is not tracked in the CNDDB. However, data compiled by the Conservation Biology Institute (CBI) includes at least six mapped occurrence locations within the Desert Renewable Energy Conservation Plan (DRECP) Area (Figure SP-M02) (Data Basin 2013). Three of the occurrences were along or near the Colorado River, including one near Blythe and the other two in the Palo Verde Area. Two adjacent occurrences are located in the Smoketree Valley area and the other occurrence is near Clemens Well in the valley between the Orocopia and Chocolate mountains. The most recent available estimates made to assist with

hunting and herd management put the current burro deer population at about 2,000 individuals (CDFG 2007).

Natural History

Habitat Requirements

The burro deer is a large ungulate that shifts seasonally between desert riparian washes and more open, mountainous terrain. It depends on the availability of water and tracks the best available forage throughout the year. Burro deer need to drink at least every 3–4 days, but tend to drink each night, and therefore require predictable water sources. Consequently, their seasonal distribution is closely associated with water availability (Celentano and Garcia 1984).

During the driest season, between January and March, deer concentrate in lowland riparian habitats, including riparian forest, alluvial and riparian scrub, and alluvial woodland, where water is predictable and forage vegetation quality is relatively high. With the onset of the summer monsoonal rains in July and August, burro deer are less constrained by water sources and use the network of alluvial and wash communities to migrate between lowland riparian communities and the mountainous desert communities that include Sonoran Desert scrub, alluvial woodland, and Joshua tree woodland (Celentano and Garcia 1984; Marshal et al. 2006a) (Table 1). Burro deer remain at high elevations throughout the autumn and winter (Marshal et al. 2006a), only returning to more predictable forage and water sources at lower elevations in spring (Table1).

Burro deer track the highest quality forage, which depends on monsoonal and winter rainfall. Monsoonal rainfall in particular can be highly localized, and consequently forage quality is very heterogeneous (Marshal et al. 2006a, 2006b). As a result, burro deer abundance and distribution can be highly variable from year to year (Marshal et al. 2006c).

Table 1. Habitat Associations for Burro Deer

Land Cover Type	Land Cover Use	Habitat Designation	Habitat Parameters	Supporting Information
Riparian Forest; Alluvial and Riparian Scrub; Alluvial Woodland; Desert Dunes.	Shelter and foraging	Spring, early Summer	Xeroriparian washes, riparian habitats used for shelter and foraging.	Celentano and Garcia 1984; Marshal et al. 2006a
Sonoran Desert Scrub; Alluvial Woodland; Joshua Tree Woodland.	Rutting/ fawning/ foraging	Summer/ Autumn/ Winter	Females and fawns steeper slopes, avoiding ridges and valley flats.	Marshal et al. 2006a; Marshal et al. 2006c

Foraging Requirements

Burro deer foraging patterns vary seasonally and are dictated by water availability and quality of forage plants (Marshal et al. 2006a). Their forage is dominated by browse and forbs, with only 10% of their diet consisting of grasses and succulents (Krausman et al. 1997; Marshal et al. 2006b, 2012). During the driest season, in spring and pre-monsoonal summer, burro deer are closely associated with water sources and, consequently, rely on riparian, xeroriparian, and desert wash communities that produce most of the high-quality forage. Forage plants include catclaw (*Acacia greggii*), desert ironwood (*Olneya tesota*), palo verde (*Parkinsonia florida*), honey mesquite (*Prosopis glandulosa*), and cheese bush (*Hymenoclea salsola*). Deer foraging adjacent to the Colorado River include salt cedar (*Tamarix* spp.), cattails (*Typha domingensis*), and arrowweed (*Pluchea sericea*) in their diet (Marshal et al. 2004, 2006b, 2012).

Following the onset of the monsoon between late July and early August, burro deer are less constrained by water sources and are found on steeper ground at high elevations (Marshal et al. 2006a).

Common forage plants for burro deer in piedmont and mountainous areas are creosote bush (*Larrea tridentata*), burro-weed (*Ambrosia dumosa*), brittle-bush (*Encelia farinosa*), and ocotillo (*Fouquieria splendens*) (Marshal et al. 2006b).

As noted above, burro deer forage is dominated by browse vegetation. Microhistological examination of deer pellets found that diets of burro deer had high proportions of browse (76%–85%) in all seasons and low proportions of grasses (1%–2%) and forbs (4%–8%). Browse plants were dominated by saltbush (*Atriplex* spp.), Mexican tea (*Ephedra californica*), desert ironwood, palo verde, and honey mesquite (Marshal et al. 2004, 2012).

Reproduction

Burro deer tend to rut and mate later than most mule deer (Heffelfinger 2006). Rutting and mating may occur as early as late December and as late as March (Table 2) (Celentano and Garcia 1984; Marshal et al. 2006a).

Fawning occurs between July and mid-October (Table 2), timed to take advantage of summer monsoon rains. Fawning occurs in both riparian and mountainous desert habitats, although observations made during fawning indicate that it occurs in areas characterized by low hills with a network of interconnecting washes (Celentano and Garcia 1984). Does with fawns then move into more mountainous terrain where they have a tendency to avoid valley floors and ridges, which are associated with higher predator densities (Marshal et al. 2006a). Fawns are believed to be susceptible to coyote (*Canis latrans*) and golden eagle (*Aquila chrysaetos*) predation until they are at least 6 months old (Marshal et al. 2006a).

Table 2. Key Seasonal Periods for Burro Deer

	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Rutting/ Breeding	X	X	X									
Migration							X	X				
Fawning/ rearing of young							X	X	X	X	X	

Sources: Celentano and Garcia 1984; Marshal et al. 2006a

Spatial Activity

Burro deer generally follow a seasonal migratory pattern in the Plan Area. During the drier spring and summer periods, burro deer occur in riparian woodlands and washes bordering major water sources such as the Colorado River, Coachella Canal, or All American Canal. As the summer monsoonal rains arrive, between late July and August, burro deer migrate to the desert mountains, coinciding with the flush of new growth for desert forage plants and raising fawns (Celentano and Garcia 1984). Burro deer only shift back to the lowlands in spring as temporary waters sources dry out. Migration is not universal, however, and some burro deer remain around permanent water sources in the Chocolate Mountains (Celentano and Garcia 1984).

Home range patterns vary considerably between seasons. During the hot spring and summer months, deer are restricted to permanent water sources and do not range far. Burro deer occupying Colorado River riparian woodlands may have home range as small as 1 square mile, while deer in dry wash woodland may have home ranges of 2–8 square miles (Celentano and Garcia 1984). During the cooler winter months, when movement is not restricted by water or high temperatures, individual ranges in the mountains may cover 30–50 square miles (Table 3).

Table 3. Movement Distances for Burro Deer

Type	Distance/Area	Location of Study	Citation
Home Range Summer	1–8 square miles		Celentano and Garcia, 1984
Home Range Winter	15–30 square miles		Celentano and Garcia 1984

Ecological Relationships

Rainfall has an important influence on mule deer populations in the deserts of Southern California, with both abundance and population dynamics related to the amount of rainfall. Forage resources in deserts are affected primarily by rainfall, which is highly variable seasonally between years and across the range. As a result, resource availability and its influence on deer populations is highly variable from year to year (Marshal et al. 2002, 2005). Despite these general relationships, however, there is currently no direct evidence linking burro deer population dynamics to the large-scale climatic variation caused by El Niño southern oscillation events (Marshal and Bleich 2011).

During the summer monsoonal season, rainfall events tend to produce strip rains, where a large amount of rain falls on an area about 1 kilometer wide and several kilometers long, with little rain falling on adjacent areas. Strip rains produce a highly heterogeneous response in plant growth (Marshal et al. 2005) and a patchy distribution of forage biomass and quality. Burro deer respond to this heterogeneity by selecting areas with rapidly growing plants, such as those in areas that recently received rainfall, because forage from those plants are high in water, protein, and digestibility. When rapidly growing forage is not available, deer may select areas of high forage biomass, where they can take advantage of forage of higher digestibility before plant biomass and digestibility decrease. When forage water decreases beyond a critical threshold, however, locations of permanent water, including catchments, may become most important in determining deer distribution, and forage growth and biomass become secondary to water availability (Marshal et al. 2005).

It is unclear to what degree mule deer compete or interact with other large- and medium-sized herbivores in the area, such as bighorn

sheep (*Ovis canadensis*), feral ass (*Equus asinus*), black-tailed jackrabbit (*Lepus californicus*), desert cottontail (*Sylvilagus audubonii*), and desert tortoise (*Gopherus agassizii*). Studies assessing the overlap between deer and the feral ass indicate biologically significant overlap, but with the burro deer diet containing more browse and forbs and significantly less grass than the ass (Marshal et al. 2012). Burro deer and bighorn sheep may share diets where their habitats overlap, but they exhibit seasonal separation. In the driest periods of spring and summer, when bighorn sheep may use desert washes, burro deer tend to concentrate in riparian habitats.

Potential predators of burro deer include mountain lion (*Puma concolor*), coyote, bobcat (*Lynx rufus*), and golden eagle. However, the extent to which predators affect burro deer populations is currently unknown. Marshal et al. (2006a) suggest that predators, particularly coyote, may be responsible for females with fawns avoiding valley floors and ridges until the fawns are at least 6 months old. Predator exclusion experiments in Arizona have shown that predation is a significant factor in fawn mortality (Heffelfinger 2006).

Population Status and Trends

Global: Secure (NatureServe 2012)
State: Stable
Within Plan Area: Stable

Burro deer are not currently listed as threatened or special status, but are managed in California for their recreational, educational, and hunting value. Available evidence suggests the population is stable. Past surveys estimated a population of about 2,000 individuals (Celentano and Garcia 1984), with estimates in the 1980s and 1990s varying between 2,000 and 5,000 individuals (CDFG 1997). More recent estimates in the early 2000s from telemetric and remote photographic studies estimate herd densities of 0.05–0.13 deer per square kilometer (Marshal et al. 2006c), indicating a population in the in the range of 970 and 2,500 individuals.

For hunting purposes, population trends and herd health have generally been inferred from harvest data, climatic conditions, and plant productivity (Celentano and Garcia 1984). However, deer harvests

observed a fourfold increase between 1948 and 1998 (Marshal et al. 2002). Such an increase is a reflection of increased hunting intensity and changes in reporting methods for harvested deer (Celentano and Garcia 1984; CDFG 1997). The increased hunting intensity has, thus far, had no detectable effect upon the population. Current population size and composition are estimated from harvest models, developed in the mid-2000s. The most recent available estimate for 2007 puts the population close to historical levels: 1,940 individuals in 2007 compared to 2,000 individuals in 1940 (CDFG 2007).

Estimates of herd composition are highly variable (Table 4). Celentano and Garcia (1984) estimated sex and age ratio using aerial and ground telemetry, and Thompson and Bleich (1993) tested the efficacy of ground, aerial, and hunter surveys in estimating herd composition but did not estimate abundance. The most recent population estimates for the East Chocolate–Cargo Muchacho area concluded that burro deer occur at densities between 0.05-0.13 deer per square kilometer. This estimate is comparable to the historical estimates of deer densities of 0.08 deer per square kilometer in 1940 and 0.11 deer per square kilometer in 1952 (Marshal et al. 2006c).

The extensive telemetry and remote photography studies conducted between 1999 and 2004 focused on demographic composition, habitat utilization, and potential interactions with other large herbivores such as feral ass. It is evident from these most recent studies that observed abundance and density are highly variable between years, and consequently estimating long-term trends in herd size and health from just a few years of data is difficult (Marshal et al. 2006a, 2006b, 2006c, 2012; Marshal and Bleich 2011).

Table 4. Estimated Herd Composition Ratios from Three Studies of Burro Deer in California

Year	Female	Young	Male	Method
1981[1]	100	65	No estimate	Aerial and ground telemetry
1982[1]	100	56	No estimate	Aerial and ground telemetry
1990[2]	100	25	35	Aerial survey
	100	43	29	Ground survey
	100	35	31	Hunter interviews
1999[3]	100	28	9	Remote photography and aerial telemetry
2000[3]	100	17	33	Remote photography and aerial telemetry
2001[3]	100	10	55	Remote photography and aerial telemetry
2002[3]	100	71	38	Remote photography and aerial telemetry
2003[3]	100	43	40	Remote photography and aerial telemetry
2004[3]	100	85	61	Remote photography and aerial telemetry

[1] Celentano and Garcia 1984
[2] Thompson and Bleich 1993
[3] Marshal et al. 2006c

Threats and Environmental Stressors

Historically burro deer have faced a range of threats from activities associated with an increasing human population in southeastern California. Development and agriculture along the Colorado River has reduced access to the summer riparian habitats, introduced invasive species such as salt cedar, and reduced the availability of native habitats. In addition, increased recreation development and flood control measures have contributed to reduced available summer habitat.

In areas away from the riparian lowlands, increased recreational use of desert washes by off-highway vehicles (OHVs) has resulted in localized disturbances of burro deer, and effectively has reduced connectivity between riparian and mountain habitats. Other localized impacts include mining operations and energy development (Celentano and Garcia 1984).

Historically, poaching, road kill, and drowning in canals have all been identified as significant sources of mortality, although measures taken to reduce road kill and drowning have had some success in reducing these mortality factors (CDFG 1995).

Competition from non-native grazing animals such as feral ass may represent a long-term pressure in shared habitat (Celentano and Garcia 1984; CDFG 1997). The most recent research confirms significant biological overlap in the diet of both species (Marshal et al. 2012).

Other threats found throughout the southwestern desert region include introduction of non-native pasture plants; overstocking and competition from cattle, domestic sheep, and goats; and extensive oil and gas development. However, as yet, these threats appear to be absent from the Southern California range of burro deer (Heffelfinger et al. 2006; Heffelfinger 2006).

Conservation and Management Activities

Several management activities have been implemented specifically to benefit burro deer, or for other species that also benefit the subspecies.

The 1984 *Burro Deer Herd Management Plan* (Celentano and Garcia 1984) was prepared in response to possible stressors and threats from development, agriculture, poaching, and OHVs. The management plan identified actions to maintain habitat health and connectivity as well as actions to mitigate known anthropogenic sources of mortality. The plan included the following key action points:

a) Maintain access to riparian habitats in summer by controlling recreational uses of riparian habitats, and ensuring agricultural practices are sympathetic to deer requirements.

b) Maintain contiguous access between summer riparian habitat and winter mountain habitats by ensuring desert wash systems are maintained and not fragmented by development.

c) Manage access of OHVs to desert wash habitats in core deer population areas.

d) Reduce road kill incidences along State Highways 78 and 95 by promoting the construction of fencing and underpasses that allow deer to travel between the Colorado River and mountainous habitats.

e) Ensure that artificial canal construction uses methods that reduce likelihood of deer drowning; e.g., implementation of 2:1 slopes, use of linear curbing.

f) Reduce illegal hunting.

g) Document the effectiveness of water source development, i.e., developing catchments that improve availability of free water. This serves two goals: (1) reduces the reliance of deer on open canals as a water source in the driest parts of the year, and thus reduces the risk of drowning; and (2) improves overall access to water for the wider herd.

Desert Wildlife Unlimited Inc. is also involved in providing and maintaining drinkers for desert wildlife, including burro deer. The organization employs 12,000-gallon fiberglass tanks with a step drinker attached, which require relatively little maintenance (Desert Wildlife Unlimited Inc. 2013).

While historically access to permanent water sources has been viewed as the most significant factor limiting desert wildlife, and improvement of water sources has therefore been a primary goal of conservation management (Celentano and Garcia 1984), water sources may only be a limiting factor in the hottest and driest seasons. Throughout much of the year, herd size limitations may be a function of available forage (Marshal et al. 2006b). More recent management recommendations have focused on methods for improving forage availability.

The burro deer should also benefit from habitat conservation and management measures being implemented by the Lower Colorado River Multi-Species Conservation Program (LCR MSCP 2004).

Although the burro deer is not a covered species under the LCR MSCP, one of the conservation measures in the LCR MSCP is to provide replacement riparian habitat, which would benefit burro deer, including removal of tamarisk and replacement with suitable native habitat. An LCR MSCP conservation goal is to create 765 acres of cottonwood-willow and honey mesquite vegetation.

Data Characterization

Burro deer are generally well studied, at least from the perspective of game management. The burro deer herd is managed for harvesting as part of the broader mule deer population in California. Because of its unique desert habitat and management needs, it is managed within its own Deer Management Unit (D12). Annual harvest records are collected from hunters and used in conjunction with fall herd composition data and spring surveys to predict the available bucks for the next hunting season (CDFG 2007, 2010).

Efforts to quantify burro deer population parameters, including population trends and health, have been more difficult because of low densities and low detection probabilities (Thompson and Bleich 1993). Celentano and Garcia (1984) provided estimates of herd density and habitat utilization, but identified a lack of long-term data pertaining to (a) herd age class and sex composition, (b) effects of predators, and (c) effects of illegal kills.

Subsequent studies largely focused on understanding herd composition and age structure (e.g., Thompson and Bleich 1993; Marshal et al. 2005, 2006c), and on quantifying the relationship between rainfall, forage quality, population fluctuations, and management activities (Marshal et al. 2002, 2006a, 2006b, 2012; Marshal and Bleich 2011). However, explicit studies examining the impacts of predators and poaching on this subspecies are absent from the scientific literature. Further, most of the recent studies have been focused in the east Chocolate–Cargo Muchacho areas, providing little information on the status of the herd across the entirety of its range.

Management and Monitoring Considerations

Ongoing management of burro deer herds includes actions to monitor and maintain habitat quality and connectivity as well as activities to reduce known sources of anthropogenic mortality:

- Management of development within riparian and xeroriparian habitats to ensure access between summer and winter ranges to riparian habitats and clear migration corridors along desert washes (Celentano and Garcia 1984; CDFG 1994, 1995).
- Ongoing monitoring of the effects of illegal hunting (CDFG 1995).
- Assessment and management of feral ass populations to reduce potential competitive effects (CDFG 1997).
- Assessment and development of alternative forage management and enhancement methods to improve quantity and quality of available forage (Marshal et al. 2006a).

Predicted Species Distribution in Plan Area

This section provides the results of habitat modeling for burro deer, using available spatial information and occurrence information, as appropriate. For this reason, the term "modeled suitable habitat" is used in this section to distinguish modeled habitat from the habitat information provided in Habitat Requirements, which may include additional habitat and/or microhabitat factors that are important for species occupation, but for which information is not available for habitat modeling.

The model generated 1,150,569 acres of modeled suitable habitat for burro deer within the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

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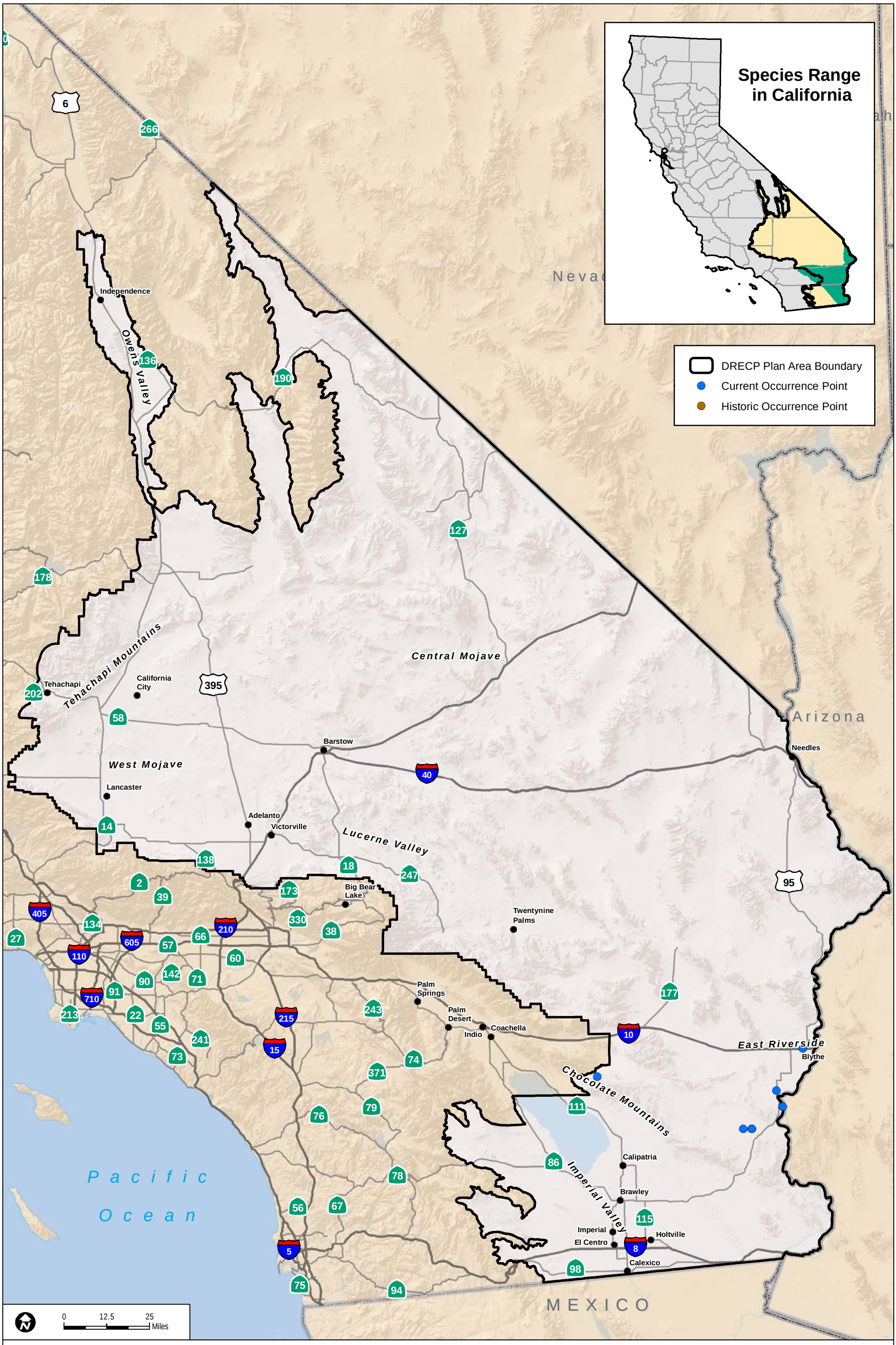

Sources: ESRI (2014); DRECP Species Occurrence Database (2013), CWHR (2008)

FIGURE SP-M02

Burro Deer Occurrences in the Plan Area