

Status of the Species and its Critical Habitat- Rangewide: February 9, 2012

1. Desert Tortoise

The following section provides an account of the species and summarizes information about the desert tortoise relative to its legal/listing status, recovery planning (recovery plan and recovery units), population trends, our 5-year review of the species (Service 2010), habitat and population connectivity, and current threats. Please refer to the Revised Recovery Plan for the Mojave Population of the Desert Tortoise (Service 2011a) and references therein, and the 5-year review for the species for additional detailed information about these topics and the species' description, ecology, life history, and habitat requirements.

a. Legal/Listing History

On August 20, 1980, the Service published a final rule listing the Beaver Dam Slope population of the desert tortoise in Utah as threatened and designated 16,640 acres of BLM-administered land as critical habitat (45 Federal Register 55654). Major threats to the species identified in the rule included habitat destruction through development, overgrazing, and geothermal development, collection for pets, malicious killing, road kills, and competition with grazing or feral animals. In 1984, Defenders of Wildlife, Natural Resources Defense Council, and Environmental Defense Fund petitioned the Service to list the species as endangered. The following year, we determined that listing the desert tortoise as endangered was warranted, but higher priorities precluded any action.

In 1989, more information regarding threats to desert tortoises became available prompting the Service to publish an emergency rule listing the Mojave population (all desert tortoises north and west of the Colorado River) as endangered (54 Federal Register 32326). On April 2, 1990, the Service determined the Mojave population of the desert tortoise to be threatened (55 Federal Register 12178). Reasons for the determination included significant population declines, loss of habitat from construction projects such as roads, housing and energy developments, and conversion of native habitat to agriculture. Livestock grazing and off-highway vehicle (OHV) use were identified as factors causing degradation of additional habitat. Also cited as threatening the desert tortoise's continuing existence were: illegal collection by humans for pets or consumption; upper respiratory tract disease; predation on juvenile desert tortoises by common ravens, coyotes, and kit foxes; fire; and collisions with vehicles on paved and unpaved roads.

The species was listed as threatened under the California Endangered Species Act in 1989 and is considered a species at risk under California's Wildlife Action Plan (Bunn *et al.* 2006). California Department of Fish and Game manages over 48,000 acres of land for the conservation of the desert tortoise, and additional lands acquired as mitigation for projects that result in impacts to the species. The Mojave desert tortoise is protected by state regulations in Nevada, Arizona, and Utah.

On February 8, 1994, the Service designated approximately 6.4 million acres of critical habitat for the Mojave population of the desert tortoise in portions of California, Nevada, Arizona, and

Utah (59 Federal Register 5820), which became effective on March 10, 1994.

b. Species Account

The desert tortoise is a large, herbivorous reptile that occurs in the Mojave and Sonoran deserts in southern California, southern Nevada, Arizona, and the southwestern tip of Utah in the U.S., as well as Sonora and northern Sinaloa in Mexico. The Mojave desert tortoise occurs north and west of the Colorado River in the Mojave Desert of California, Nevada, Arizona, and southwestern Utah, and in the Sonoran (Colorado) Desert in California.

Desert tortoises reach 8 to 15 inches in carapace (upper shell) length and 4 to 6 inches in shell height. Hatchlings emerge from eggs at about 2 inches in length. Adults have a domed carapace and relatively flat, unhinged plastrons (lower shell). Their shells are greenish-tan to dark brown in color with tan scute (horny plate on the shell) centers. Adult desert tortoises weigh 8 to 15 pounds. The forelimbs have heavy, claw-like scales and are flattened for digging; hind limbs are more elephantine.

Optimal habitat for the desert tortoise has been characterized as creosote bush scrub in which precipitation ranges from 2 to 8 inches, where a diversity of perennial plants is relatively high, and production of ephemerals is high (Luckenbach 1982, Turner 1982, Turner and Brown 1982). Soils must be friable enough for digging burrows, but firm enough so that burrows do not collapse. Desert tortoises occur from below sea level to an elevation of 7,300 feet, but the most favorable habitat occurs at elevations of approximately 1,000 to 3,000 feet (Luckenbach 1982).

Desert tortoises are most commonly found within the desert scrub vegetation type, primarily in creosote bush scrub. In addition, they occur in succulent scrub, cheesebush scrub, blackbrush scrub, hopsage scrub, shadscale scrub, microphyll woodland, Mojave saltbush-allscale scrub and scrub-steppe vegetation types of the desert and semidesert grassland complex (Service 1994). Within these vegetation types, desert tortoises potentially can survive and reproduce where their basic habitat requirements are met. These requirements include a sufficient amount and quality of forage species; shelter sites for protection from predators and environmental extremes; suitable substrates for burrowing, nesting, and overwintering; various plants for shelter; and adequate area for movement, dispersal, and gene flow. Throughout most of the Mojave Region, tortoises occur most commonly on gently sloping terrain with soils ranging from sandy-gravel and with scattered shrubs, and where there is abundant inter-shrub space for growth of herbaceous plants. Throughout their range, however, tortoises can be found in steeper, rockier areas (Gardner and Brodie 2000).

The size of desert tortoise home ranges varies with respect to location and year. Tortoise activities are concentrated in overlapping core areas, known as home ranges. Because tortoises do not defend a specific, exclusive area, they do not maintain territories. In the West Mojave Desert, Harless *et al* (2007) estimated mean home ranges for male desert tortoises to be 111 acres and 40 acres for females. Over its lifetime, each desert tortoise may require more than 1.5 square miles of habitat and make forays of more than 7 miles at a time (Berry 1986). In drought years, the ability of tortoises to drink while surface water is available following rains may be crucial for tortoise survival. During droughts, tortoises forage over larger areas, increasing the

likelihood of encounters with sources of injury or mortality including humans and other predators.

Desert tortoises are most active during the spring and early summer when annual plants are most common. Additional activity occurs during warmer fall months and occasionally after summer rainstorms. Desert tortoises spend most of the remainder of the year in burrows, escaping the extreme conditions of the desert. However, under certain conditions desert tortoises may be aboveground any month of the year. Generally, tortoises are considered to be most active from approximately March 1 through October 31.

Tortoise activity patterns are primarily controlled by ambient temperature and precipitation (Nagy and Medica 1986, Zimmerman *et al.* 1994). Desert tortoises are active for approximately 6 weeks to 5 months of the year, depending on annual variations of temperature and rainfall. Deserts are characterized by prolonged periods of barely measurable rainfall. In much of the Mojave Desert, droughts of 8 months or more occur regularly. During such times, the desert is virtually devoid of food for tortoises except for cacti and dried grasses (Oftedal 2002). In the East Mojave and Colorado Deserts, annual precipitation occurs in both summer and winter, providing food and water to tortoises throughout much of the summer and fall. Most precipitation occurs in winter in the West Mojave Desert resulting in an abundance of annual spring vegetation, which dries up by late May or June. Tortoises in the West Mojave are primarily active in May and June, with a secondary activity period from September through October.

Tortoises may also be active during periods of mild or rainy weather in summer and winter. During inactive periods, tortoises rest in subterranean burrows or caliche caves, and spend approximately 98 percent of the time in these shelter sites (Nagy and Medica 1986). During active periods, they usually spend nights and the hotter part of the day in their burrow; they may also rest under shrubs or in shallow burrows (pallets). Tortoises may use an average of 7 to 12 burrows at any given time (Bulova 1994, TRW Environmental Safety Systems Inc.1997).

Walde *et al* (2003) observed that desert tortoises retreated into burrows when air temperature reached $91.0^{\circ}\text{F} \pm 3.55^{\circ}\text{F}$ and ground temperatures reached $94.6^{\circ}\text{F} \pm 6.05^{\circ}\text{F}$; 95 percent of desert tortoise observations of desert tortoises above ground occurred at air temperature less than 91°F . The body temperature at which desert tortoises become incapacitated ranges from 101.5°F to 113.2°F (Naegle 1976, Zimmerman *et al.* 1994).

Although desert tortoises eat alien plants, they generally prefer native forbs when available (Jennings 1993, Avery 1998). Consumption of alien plants may place them at a nitrogen and water deficit (Henen 1997). Frequent droughts place tortoises at even greater water and nitrogen deficit than during moderate or high rainfall years (Peterson 1996, Henen 1997). During a drought, more nitrogen than normal is required to excrete nitrogenous wastes, thus more rapidly depleting nitrogen stored in body tissues. Plants also play important roles in stabilizing soil and providing cover for protection from predators and heat.

Further information on the range, biology, and ecology of the desert tortoise can be found in Berry and Burge (1984), Brooks (2003), Burge (1978), Burge and Bradley (1976), Bury *et al.*

(1994), Gardner and Brodie 2000; Germano *et al.* (1994), Hovik and Hardenbrook (1989), Jennings (1997), Karl (1981, 1983a, 1983b), Luckenbach (1982), Nussear *et al.* (2009), Oftedal 2002; Service (2010, 2011), Tracy *et al.* 2004; Van Devender (2002); and Weinstein *et al.* (1987).

c. Recovery Plan for the Desert Tortoise

The first recovery plan for the desert tortoise was published in 1994, together with a companion document identifying 14 proposed desert wildlife management areas (DWMAs; Service 1994) within six recovery units. The recovery plan serves as the basis and key strategy for recovery and delisting of the species. Within each DWMA, the recovery plan recommends implementation of reserve-level protection of desert tortoise populations and habitat, while maintaining and protecting other sensitive species and ecosystem functions. The recovery plan also recommends that DWMAs be designed to follow the accepted concepts of reserve design and be managed to restrict human activities that negatively affect desert tortoises (Service 1994).

The Service released the final revised recovery plan in 2011 (Service 2011). The revised recovery plan refines the recovery and delisting criteria and reduced the number of recovery units from six to five. Since 1994, research pertaining to ecological and genetic variation has provided important insights into patterns of distribution within the Mojave desert tortoise population. This information was used to define the recovery unit boundaries in a manner that balances distinctiveness and variability within the population. Maintaining local adaptation as well as genetic diversity over time is important for recovery; thus, applying these concepts at the appropriate recovery unit level will facilitate prioritization of recovery and management activities within the various geographic units.

The goals of the recovery plan are recovery and delisting of the desert tortoise. The recovery objectives and criteria below represent our best assessment of the conditions that would most likely result in a determination that delisting of the desert tortoise is warranted.

Recovery Objective 1 (Demography). Maintain self-sustaining populations of desert tortoises within each recovery unit into the future.

Recovery Criterion 1. Rates of population change for desert tortoises are increasing over at least 25 years (a single tortoise generation), as measured by a) extensive, rangewide monitoring across tortoise conservation areas within each recovery unit, and b) direct monitoring and estimation of vital rates (recruitment, survival) from demographic study areas within each recovery unit.

Recovery Objective 2 (Distribution). Maintain well-distributed populations of desert tortoises throughout each recovery unit.

Recovery Criterion 2. Distribution of desert tortoises throughout each tortoise conservation area is increasing over at least 25 years.

Recovery Objective 3 (Habitat). Ensure that habitat within each recovery unit is protected and

managed to support long-term viability of desert tortoise populations.

Recovery Criterion 3. The quantity of desert tortoise habitat within each desert tortoise conservation area is maintained with no net loss until tortoise population viability is ensured. When parameters relating habitat quality to tortoise populations are defined and a mechanism to track these parameters established, the condition of desert tortoise habitat should also be demonstrably improving.

d. Recovery Units

The recovery units in the revised recovery plan were mapped with the aid of modern GIS tools, much more precisely than in 1994; however, transitions between recovery units are not always as precise on the ground as depicted by lines on a map. The Service reduced the number of recovery units from six to five and changed some boundaries of the 1994 recovery units, as described and justified below.

(1) Upper Virgin River Recovery Unit. This recovery unit is equivalent to the original Upper Virgin River Recovery Unit in the 1994 Recovery Plan and encompasses all desert tortoise habitat in Washington County, Utah, east of the Beaver Dam Mountains. Unique habitat characteristics and tortoise behavior in this region justify separating the most northern extreme of the tortoise's range, east of the Beaver Dam Mountains, into a separate recovery unit. Here the animals live in a complex topography consisting of canyons, mesas, sand dunes, and sandstone outcrops where the vegetation is a transitional mixture of sagebrush (*Artemisia* spp.) scrub, creosote bush scrub, blackbrush scrub, and a psammophytic (sandy-soil) community. Desert tortoises often use sandstone and lava caves instead of burrows, travel to sand dunes for egg laying, and use still other habitats for foraging.

Recent DNA microsatellite evidence (Hagerty and Tracy 2010) suggests that there is little genetic differentiation between the Upper Virgin River and the neighboring recovery unit, which supports findings from allozyme (protein) and mitochondrial DNA (mtDNA) markers (Lamb *et al.* 1989; Britten *et al.* 1997). Although assignment tests correctly placed 95 percent of individuals in the Upper Virgin River Recovery Unit (Murphy *et al.* 2007), samples from nearby populations west of the Beaver Dam Mountains were not included in the study.

(2) Northeastern Mojave Recovery Unit. This recovery unit is similar to the 1994 designation, extending into extreme southwestern Utah and northwestern Arizona, but excluding portions south of Las Vegas. The east end of the unit extends south from the Beaver Dam Mountains, across the north end of the Virgin Mountains, down to the Colorado River. From the Colorado River at Las Vegas Bay, the southern boundary extends west generally along Las Vegas Wash through the city of Las Vegas to the Spring Mountains. From here, the western boundary extends north up the Sheep Mountains.

Recent DNA microsatellite data indicate that this unit is genetically similar to the Upper Virgin River Recovery Unit, but the Northeastern Mojave Recovery Unit does contain distinct microsatellite differences compared to the remainder of the range (Hagerty and Tracy 2010). The Sheep Mountains down to the Spring Mountains act as a near barrier for the western portion

of this unit. Some variation may occur to the south and west from the Mormon Mesa, but genetic breaks appear to be ambiguous relative to at least semi-permeable topographic barriers to gene flow, such as the Muddy Mountains. An allozyme cluster at one locus from populations in the Mormon Mesa critical habitat unit overlaps another cluster identified from populations in Piute Valley in the Eastern Mojave Recovery Unit (Britten *et al.* 1997). A distinct shell phenotype also occurs in the Beaver Dam Slope region (Service 1994; Britten *et al.* 1997), but these tortoises are not genetically isolated from adjacent populations within the recovery unit (Bury *et al.* 1994).

Desert tortoises in this recovery unit are generally found in creosote bush scrub communities of flats, valley bottoms, alluvial fans, and bajadas, but they occasionally use other habitats such as rocky slopes and blackbrush scrub. Desert tortoises are often active in late summer and early fall, in addition to spring, reflecting the fact that this region receives up to about 40 percent of its annual rainfall in summer and supports two distinct annual floras on which tortoises can feed. Average daily winter temperatures usually fluctuate above freezing, and summer temperatures are typically a few degrees cooler than in the western Mojave and Colorado deserts. Two or more desert tortoises often den together in caliche caves in bajadas and washes or caves in sandstone rock outcrops, and they typically eat summer and winter annuals, cacti, and perennial grasses.

This recovery unit includes the Beaver Dam Slope, Gold Butte-Pakoon, and Mormon Mesa critical habitat units. It also includes Lake Mead National Recreation Area south to Las Vegas Bay, Grand Canyon-Parashant National Monument on the Arizona Strip, and the eastern edge of Desert National Wildlife Range.

(3) *Eastern Mojave Recovery Unit.* This recovery unit is similar to the 1994 designation, spanning the Nevada-California border, including Oasis Valley, Amargosa Desert, Pahrump Valley, and extending south into Shadow Valley, but now including habitat north of the Spring Mountains east to the Sheep Mountains as well as Las Vegas and Eldorado valleys north to the city of Las Vegas. The Eastern Mojave Recovery Unit borders the Northeastern Mojave Recovery Unit to the east, extending down the Sheep Mountains to the Spring Mountains, east to Las Vegas Bay on Lake Mead, then down the Colorado River. From the Colorado River at approximately Cottonwood Cove, the southern boundary extends west through Searchlight, down the New York and Providence mountains to the Granite Mountains. From there the western boundary extends north through the Bristol Mountains, Soda Lake, and Silurian and Death valleys. The Spring Mountains, which provided much of the separation between the former Northeastern Mojave and Eastern Mojave recovery units, narrowly channel gene flow through habitat corridors to the north and south, connecting this recovery unit to the Northeastern Mojave Recovery Unit (Hagerty 2008; Hagerty *et al.* 2010).

A majority of this unit had not been sampled previously; however, recent microsatellite data reflect unique nuclear allele frequencies, indicating that this area is relatively isolated from other recovery units (Hagerty and Tracy 2010). Allele frequencies from tortoises at Amargosa Desert and Pahrump Valley sites also form a homogeneous cluster different from other Nevada sites (Britten *et al.* 1997). The Sheep Mountains appear to form a barrier to tortoise movement between the eastern side of the recovery unit and the Northeastern Mojave Recovery Unit. The

New York and Providence mountains isolate Ivanpah/Shadow valleys from Eldorado/Fenner valleys in the Colorado Desert Recovery Unit to the east. Saline Valley and Death Valley extending south into Silurian Valley and Soda Dry Lake act as a barrier between this recovery unit and the Western Mojave Recovery Unit. Although gene flow likely occurred intermittently during favorable conditions across this western edge of the recovery unit, this area contains a portion of the Baker Sink, a low-elevation, extremely hot and arid strip that extends from Death Valley to Bristol Dry Lake. This area is generally inhospitable for desert tortoises.

Desert tortoises in this recovery unit are generally found in creosote bush scrub communities of flats, valley bottoms, alluvial fans, and bajadas, but they occasionally use other habitats such as rocky slopes and blackbrush scrub. As in the northeastern Mojave Desert, desert tortoises are often active in this recovery unit in late summer and early fall, in addition to spring, reflecting the fact that this region receives up to about 40 percent of its annual rainfall in summer and supports two distinct annual floras on which tortoises can feed. They typically eat summer and winter annuals, cacti, perennial grasses, and herbaceous perennials. Average daily winter temperatures usually fluctuate above freezing, except in the higher elevations. Summer temperatures are typically a few degrees cooler, except in the lowest elevations of Death Valley, than the recovery units to the south and west.

The recovery unit includes the east side of Death Valley National Park, much of Mojave National Preserve, and Lake Mead National Recreation Area between Las Vegas Bay and Cottonwood Cove, as well as the Nevada National Security Site (formerly the Nevada Test Site) and the western end of Desert National Wildlife Range. It also includes the Ivanpah Valley critical habitat unit and the Eldorado Valley portion of the Piute-Eldorado critical habitat unit. A lack of desert tortoise habitat dedicated to conservation to the west of the Spring Mountains and in Las Vegas Valley highlights the need for careful management in these areas to maintain connectivity among populations and the genetic variation within this recovery unit. Corridors north and south of the Spring Mountains warrant particular management attention to prevent genetic isolation of populations on either side of this mountain range.

(4) Colorado Desert Recovery Unit. This recovery unit combines the 1994 Eastern Colorado and Northern Colorado recovery units, as well as a portion of the Eastern Mojave Recovery Unit in Piute and Fenner valleys. It is primarily found in California, though it extends into Piute Valley, Nevada, in the northern corner. Patchy habitat southeast of the Cadiz Valley appears to provide some linkage and gene flow, at least historically, between the former Northern and Eastern Colorado recovery units (Nussear *et al.* 2009; Hagerty *et al.* 2010). This linkage, combined with minimal genetic differentiation and a gradient of environmental variation between units (see below), eliminates the biological justification for maintaining these as separate recovery units. Piute and Fenner valleys span the northern border of the northern Colorado Desert and southern edge of the eastern Mojave Desert. The recovery unit shares its north and west boundaries with the Eastern Mojave Recovery Unit: west from Cottonwood Cove Road, through Searchlight, down the New York and Providence mountains, to the Granite Mountains. From the Granite Mountains, the boundary extends through the Old Dad and Bristol mountains, southeast through Bristol Lake and Cadiz Valley, to the southern end of the Calumet Mountains. From there, the boundary drops down to and extends west along California State Highway 62 all the way to the San Bernardino Mountains, including the Morongo Basin. The southern boundary circumscribes

the tortoise's range east to the Colorado River.

The prominent Providence and New York mountain ranges, which transect Mojave National Preserve, largely isolate this recovery unit from the Eastern Mojave Recovery Unit to the west. Searchlight Pass is the northern boundary, which separates Eldorado and Piute valleys. The central portion of this recovery unit is separated from the Western Mojave Recovery Unit by the Baker Sink, a low-elevation, extremely hot and arid strip that extends from Death Valley to Bristol Dry Lake and Cadiz Valley. To the south, the transition between the Colorado and Mojave deserts is more subtle. However, urban development along California State Highway 62 now largely separates the two recovery units; use of this highway as the recovery unit boundary is justified based on the broad transition between the two deserts (Turner 1982) and the lack of a natural break in desert tortoise habitat. While the Baker Sink almost divides this recovery unit in half, as generally reflected in the 1994 Northern and Eastern Colorado recovery units, the Colorado Desert is a distinct biome that encompasses a continuum of climatic and floristic characteristics (Turner 1982). Furthermore, substantial historic gene flow is now recognized within the entire Colorado Desert biome (Murphy *et al.* 2007; Hagerty *et al.* 2010; Hagerty and Tracy 2010). Tortoises from the northern and eastern Colorado deserts lumped within the same basal genetic clusters in two different analytic models (Hagerty 2008). What little genetic differentiation that has been observed between the former Northern and Eastern Colorado recovery units is likely due to an absence of sampling from (at least historical) populations in the central part of the combined unit, south of Highway 62 and east of Highway 177.

Desert tortoises in this recovery unit share mtDNA haplotypes with the Western Mojave Recovery Unit (Lamb *et al.* 1989; Murphy *et al.* 2007) and possess the California shell type (Service 1994). *Haplotypes* are sets of closely linked genetic information on a single chromosome that tend to be inherited together; a chromosome is a long strand of DNA on which genes are found. These desert tortoises are differentiated from desert tortoises in the Northeastern Mojave and Western Mojave recovery units at several allozyme loci (Rainboth *et al.* 1989; Britten *et al.* 1997). Microsatellite data also support the boundary between the Colorado Desert and Northeastern Mojave and Eastern Mojave recovery units (Murphy *et al.* 2007), but less so with the Western Mojave Recovery Unit (Hagerty 2008). *Microsatellites* are repeating base pairs of DNA. Inclusion of the Fenner and Piute valleys in this recovery unit is justified by the contiguous habitat, the failure to reliably assign sampled tortoises to the correct site between Fenner and Chemehuevi valleys (Murphy *et al.* 2007), and the inclusion of individuals from these valleys as part of the Colorado Desert subunit in more extensive genetic analyses (Hagerty and Tracy 2010).

In the Colorado Desert Recovery Unit, desert tortoises are found in the valleys, on bajadas, desert pavements, rocky slopes, and in the broad, well-developed washes (especially to the south). Vegetation is characterized by relatively species-rich succulent scrub, creosote bush scrub, and blue paloverde (*Parkinsonia florida*)-ironwood (*Olneya tesota*)-smoke tree (*Psoralea argophylla*) communities. Tortoises feed on both summer and winter annuals, because this region receives about 1/3 of its annual rainfall in summer and supports two distinct annual floras on which they can feed. The climate is somewhat warmer than in other recovery units, with very few freezing days per year. Tortoises within this recovery unit near Goffs produce relatively smaller eggs, produce more eggs overall, lay their second clutches earlier, and

are smaller overall than tortoises in the Desert Tortoise Research Natural Area in the Western Mojave Recovery Unit (Wallis *et al.* 1999). Tortoises in this area also produce more eggs than similarly sized females at the Nevada National Security Site in the Eastern Mojave Recovery Unit (Mueller *et al.* 1998).

The recovery unit includes the Piute-Eldorado critical habitat unit (south of Eldorado Valley) and the Chemehuevi, Pinto Mountains, and Chuckwalla critical habitat units. This recovery unit encompasses the eastern end of Mojave National Preserve, the southernmost limits of Lake Mead National Recreation Area, Joshua Tree National Park, and the Chocolate Mountains Gunnery Range. Unprotected habitat southeast of the Cadiz Valley may provide important connectivity necessary to maintain overall genetic variability among populations in this recovery unit.

(5) *Western Mojave Recovery Unit.* This recovery unit is generally equivalent to the 1994 designation found entirely in California. It includes the central, southwestern, south-central, and part of the northern Mojave regions. The eastern boundary, which it shares with the Eastern Mojave Recovery Unit, extends down Death and Saline valleys, through Soda Lake and the Bristol Mountains, to the Granite Mountains. The eastern boundary continues down the low-lying Baker sink and Cadiz Valley, separating it from the Colorado Desert Recovery Unit. The boundary extends west along California State Highway 62 to the San Bernardino Mountains.

Habitat in California was well connected prior to human development, allowing gene flow to occur over long geographic distances and multiple vegetation types (Murphy *et al.* 2007) and which is evidenced by results from a landscape-genetic analysis which illustrated diffuse gene flow throughout the recovery unit (Hagerty *et al.* 2010). The north half of this recovery unit borders the Eastern Mojave Recovery Unit along the Baker Sink, a low-elevation, extremely hot and arid strip that extends from Death Valley to Bristol Dry Lake and Cadiz Valley. To the south, the transition between the Colorado and Mojave deserts is more subtle. However, urban development along California State Highway 62 now largely separates the Western Mojave and Colorado Desert recovery units.

Microsatellite evidence concerning the degree of differentiation between the Western Mojave and Colorado Desert recovery units is conflicting, although genetic differentiation is generally low (Murphy *et al.* 2007; Hagerty and Tracy 2010). Morphological characteristics and mtDNA from populations in the Western Mojave also overlap those in the Colorado Desert Recovery Unit (Lamb *et al.* 1989; Service 1994; Murphy *et al.* 2007). Yet, tortoises in the west Mojave from the Kramer Hills region are differentiated from desert tortoises at in the Chemehuevi Valley in the Colorado Desert Recovery Unit at several allozyme loci (Rainboth *et al.* 1989). There is significant genetic differentiation between the Western Mojave Recovery Unit and the adjacent Eastern Mojave Recovery Unit (Murphy *et al.* 2007; Hagerty and Tracy 2010). There also may be some sub-structuring within the Western Mojave Recovery Unit (Murphy *et al.* 2007), which, like the differentiation between this and the Colorado Desert Recovery Unit, may be an artifact of discrete sampling within generally continuous habitat. Substructuring within the Western Mojave Recovery Unit was not found under more continuous sampling (Hagerty and Tracy 2010).

A pronounced difference between the Western Mojave and other recovery units, including the

closely allied Colorado Desert Recovery Unit, is in timing of rainfall and the resulting vegetation. In the Western Mojave Recovery Unit, most rainfall occurs in fall and winter and produces winter annuals, which are the primary food source of tortoises. The Western Mojave Recovery Unit contains a unique combination of vegetation types, including the Mojave saltbush (*Atriplex* spp.)-allscale (*A. polycarpa*) scrub complex, blackbrush scrub, cheesebush (*Hymenoclea salsola*) scrub, iodinebush (*Allenrolfea occidentalis*)-alkali scrub complex, desert needlegrass (*Achnatherum speciosum*) scrub steppe, big galleta (*Pleuraphis rigida*) scrub steppe, and the Indian ricegrass (*Achnatherum hymenoides*) scrub-steppe complex, extending slightly into the southwestern Colorado Desert. Above-ground activity occurs primarily (but not exclusively) in spring, associated with winter annual production. Thus, tortoises are adapted to a regime of winter rains and rare summer storms. Here, desert tortoises occur primarily in valleys, on alluvial fans, bajadas, and rolling hills. The extreme differences in precipitation and food availability relative to the other recovery units correspond to different foraging and activity patterns as well as to different life history characteristics. Tortoises dig deep burrows (usually located under shrubs on bajadas) for winter hibernation and summer estivation due to generally warm summers and cold winters. Tortoises in the Desert Tortoise Research Natural Area within this recovery unit produce relatively larger eggs, produce fewer eggs overall, lay their second clutches later, and are larger overall than tortoises near Goffs in the Colorado Desert Recovery Unit (Wallis *et al.* 1999). Tortoises in the western Mojave Desert have the smallest reported minimum size at first reproduction (less than 7 inches) compared to populations in other recovery units (Germano 1994). Behaviorally, western Mojave tortoises are much less active during summer than are tortoises in other recovery units.

The recovery unit includes the Fremont-Kramer, Superior-Cronese, and Ord-Rodman critical habitat units. The recovery unit also includes the western half of Death Valley National Park, Marine Corps Air Ground Combat Center, Fort Irwin National Training Center, China Lake Naval Weapons Center, and Edwards Air Force Base.

e. Population Trends

In 1999, the Desert Tortoise Management Oversight Group endorsed the use of line distance sampling (Buckland *et al.*, 2001) as the method for estimating rangewide desert tortoise density and population trends. From 2001 to 2005, and again from 2007 through 2009, desert tortoise populations in 5 of the 6 recovery units have been part of a coordinated, rangewide monitoring program using line distance sampling. The Upper Virgin River Recovery Unit is monitored by Utah Division of Wildlife Resources. The rangewide monitoring effort is directed each year at 13 strata that will be used to describe long-term trends. Training is provided each year so that field crews are familiar with the specifics of distance sampling. Training also ensures consistency among the many crews collecting data.

Four parameter estimates contribute to final reported tortoise densities in each monitoring stratum. The basis for distance sampling is the estimation of the number of tortoises detected at increasing distances from the walked transect. As the surveyors look farther from the transect centerline, they will detect fewer and fewer of the tortoises that are actually there, so describing the way detections decrease with distance allows for estimation of the proportion that were present but not detected within a given distance of the transect centerline. Second, an estimate is

made of the proportion above ground or visible in their burrows and available to be detected on transects. Third, the first two estimates are combined with the number of tortoises encountered per kilometer walked to provide the actual density in each stratum. Finally, the proportion detected on the line must be estimated.

Density estimates were generated separately for each monitoring stratum, and then weighted by stratum area to arrive at average density in the monitored area of each recovery unit monitored by the Service’s annual population monitoring program (Table 1). When the annual estimates are imprecise, it should not be expected that there will be a close match from one year to the next. Over a period of many years, however, any underlying trend in the number of tortoises should be obvious through this “background noise.” Our 5-year review and annual reports on population monitoring provide additional information on desert tortoise population trends and distribution. Annual reports may be found on the internet at:
http://www.fws.gov/nevada/desert_tortoise/index.html.

Table 1. Estimated density of desert tortoises in monitored areas for five recovery units in 2010.

Recovery Unit¹	Area Surveyed (km²/mi²)	No. Transects	Tortoises detected	Density/ (km²/mi²)	SE(Density)	% CV (Density)
Eastern Colorado	3472 / 1341	94	72	5.8 / 15.0	1.09	18.8
Eastern Mojave	6030 / 2328	95	45	3.6 / 9.3	1.10	30.3
Northeastern Mojave	3850 / 1486	425	164	3.2 / 8.3	0.52	15.9
Northern Colorado	3572 / 1379	40	24	4.4 / 11.4	1.56	35.6
Western Mojave	8152 / 3148	234	105	3.2 / 8.3	0.47	14.8

¹As delineated in the 1994 Recovery Plan.

f. 5-Year Review

The 5-year review for the Mojave desert tortoise discusses the status of the desert tortoise and provides information on its ecology, life history, spatial distribution, abundance, habitats, and the threats that led to its listing (i.e., the 5-factor analysis required by section 4(a)(1) of the Act (Service 2010). The 5-year review summarizes the results of the line-distance sampling. As the 5-year review notes, much of the difference in densities between years is due to variability in sampling; determining actual changes in densities will require many years of sampling. Additionally, data gathered by line-distance sampling cannot reliably be compared to information gathered through other methods at this time.

The 5-year review describes a quantitative, spatial habitat model for the Mojave desert tortoise that incorporates environmental variables such as precipitation, geology, vegetation, and slope and is based on occurrence data of desert tortoises from sources spanning more than 80 years, including data from the 2001 to 2005 rangewide monitoring surveys (Nussear et al. 2009). The model predicts the probability that desert tortoises will be present in any given location;

calculations of the amount of desert tortoise habitat in the 5-year review and in this biological opinion use a threshold of 0.5 or greater predicted value for potential desert tortoise habitat. The model does not account for anthropogenic effects to habitat.

The distribution of the desert tortoise has not changed substantially since the publication of the original recovery plan in 1994 in terms of the overall extent of its range. Prior to 1994, desert tortoises were extirpated from large areas within their distributional limits by urban development (e.g., the cities of Barstow, Lancaster, Las Vegas, St. George); agricultural areas south of Edwards Air Force Base and east of Barstow; military training (e.g., Fort Irwin); and off-road vehicle use. Since 1994, urban development around Las Vegas has likely been the largest contributor to habitat loss throughout the range. Desert tortoises have been essentially removed from the southern expansion area at Fort Irwin; a relatively small number of animals remain in this area at this time.

On an annual basis, the Service produces a recovery data call report that provides an up-to-date summary of the factors that were responsible for the listing of the species, describes other known threats and the current population trend of the species. The 2011 report describes the desert tortoise's status as 'declining,' and notes that "(a)nnual rangewide monitoring continues, but the life history of the desert tortoise makes it impossible to detect annual population increases (continued monitoring will provide estimates of moderate- to long-term population trends). Data from the monitoring program do not indicate that numbers of desert tortoises have increased since 2001. The fact that most threats appear to be continuing at generally the same levels suggests that populations are still in decline. Information remains unavailable on whether mitigation of particular threats has been successful."

In conclusion, we have used the 5-year review (Service 2010) and additional information that has become available since the publication of that review to analyze the reproduction, numbers, or distribution of the Mojave desert tortoise. The reproductive capacity of the desert tortoise may be compromised to some degree by the abundance and distribution of invasive weeds across its range. Prior to its listing, the number of desert tortoises likely declined rangewide, although we cannot quantify the extent of the decline; since the time of listing, data suggest that declines have occurred in local areas throughout the range. The distributional limits of the desert tortoise's range have not changed substantially since the issuance of the original recovery plan in 1994; however, desert tortoises have been extirpated from large areas within their range. The species' low reproductive rate, the extended time required for young animals to reach breeding age, and the multitude of threats that continue to confront desert tortoises combine to render its recovery a substantial challenge. The 5-year review concludes by recommending that the status of the desert tortoise as a threatened species be maintained.

g. Habitat and Population Connectivity

Quantifying the degree to which a landscape promotes or hinders movements among patches of habitat for a given species, hereafter referred to as "habitat connectivity" (Fischer and Lindenmayer 2007), has become increasingly important relative to desert tortoise recovery. As we evaluate utility-scale solar development and other land uses within the range of the species, it is essential that habitat linkages between and among populations are conserved. For gene flow to

occur across the range, populations of desert tortoises need to be connected by areas of occupied habitat that support sustainable numbers of reproductive individuals. Recent research provides evidence that genetic differentiation within the Mojave population is consistent with isolation by distance in a continuous-distribution model of gene flow. Populations at the farthest extremes of the distribution are therefore the most differentiated and a gradient of genetic differentiation occurs between those populations, across the range of the species (Britten *et al.* 1997, Edwards *et al.* 2004a, Murphy *et al.* 2007, Hagerty and Tracy 2010). Genetic analyses also suggest that levels of gene flow among subpopulations of desert tortoises were likely high, corresponding to high levels of habitat connectivity (Murphy *et al.* 2007, Hagerty 2008). In essence, the Mojave population historically represents a series of continuous, overlapping home ranges within suitable habitats whose boundaries between divergent units may be validated by ecological or major topographic features, such as steep mountainous terrain or, even more significantly, the Colorado River (Germano *et al.* 1994, Nussear *et al.* 2009).

Individual desert tortoises can make long-distance movements through restricted habitats, which may contribute to gene flow (Berry 1986, Edwards *et al.* 2004b), though we do not know the extent to which individuals utilize narrow corridors of relatively intact habitat. The underpinning of the continuous-distribution model of gene flow described above, and the evidence from desert tortoise population genetic studies and distribution, is that individual desert tortoises breed with their neighbors, those desert tortoises breed with other neighbors, and so on. The movements that maintain the genetic diversity across populations occur over generations and not necessarily during the life span of a single desert tortoise. Therefore, for gene flow to happen reliably, populations need to be connected across the range by occupied areas of habitat linkages that support sustainable numbers of desert tortoises.

To define the area required to maintain resident populations within the linkages, we considered desert tortoise home range size and the magnitude of edge effects. The size of desert tortoise home ranges varies with respect to location and year (Berry 1986) and may serve as an indicator of resource availability and opportunity for reproduction and social interactions (O'Connor *et al.* 1994). Females have long-term home ranges that may be as little as or less than half that of the average male, which can range to 200 acres (Burge 1977, Berry 1986, Duda *et al.* 1999, Harless *et al.* 2009). Core areas used within the lifetime home range of desert tortoises depend on the number of burrows used within those areas (Harless *et al.* 2009). Over its lifetime, a desert tortoise may use more than 1.5 miles² of habitat and may make periodic forays of more than 7 miles at a time (Berry 1986). We therefore assess the viability of the linkages based on the ability of those linkages to maintain the lifetime home range of a desert tortoise or the ability of home ranges of this size to connect to one another absent any barriers. Because we expect lifetime home ranges to expand and contract over time, we can consider whether the linkage could remain viable in a year where decreased resource availability results in a smaller population of individuals that respond by expanding their home ranges.

In assessing lifetime home ranges, the Service (1994) assumed a circular configuration of this area when using it in the population viability assessment. We based this assumption on the fidelity that desert tortoises exhibit towards an overwintering burrow year after year. Consequently, the overwintering burrow serves as an anchor point from which the lifetime utilization area radiates out. Using a circular lifetime home range of 1.5 miles² for a desert

tortoise, we estimate that a linkage would need to be at least 1.4 miles wide to accommodate the width of a single home range. Although these figures provide a means for characterizing the potential minimum width of a linkage, we do not know the exact area or land configuration required to support a sustainable population of resident desert tortoises within any particular linkage, which would be dependent upon several factors.

Based on the best available information, occupancy likely depends on many site-specific factors, including: 1) desert tortoise densities in the vicinity (i.e., lower density sites require larger areas to reliably support sustainable numbers of desert tortoises); 2) length-to-width ratio of the linkage (i.e., longer linkages may need to be wider to preserve the dynamic home ranges and interactions required for gene flow); and 3) potential edge effects and integrity of the ecosystem within and adjacent to the linkage. Another consideration is the extent to which slope and ruggedness of the terrain allows desert tortoise occupancy or passage. In addition, maintaining connectivity of desert tortoise habitats and populations should reflect results from the landscape genetic analyses of Hagerty (2008) and Hagerty *et al.* (2010). These analyses showed that desert tortoise gene flow generally occurred historically in a diffuse pattern across the landscape unless otherwise constrained to more narrow, concentrated pathways created by topographic barriers (e.g., around the Spring Mountains in western Nevada). As a result, it is evolutionarily imperative that conservation is focused on maintaining a series of redundant linkages between core populations and critical habitats.

The report prepared by the Desert Tortoise Recovery Plan Assessment Committee (Tracy *et al.* 2004) concluded that estimating accurate long-term trends of desert tortoise populations, habitat, and/or threats across the range was not feasible based on the combined suite of existing data and analyses. Instead, these data provide general insight into the rangewide status of the species and show appreciable declines at the local level in many areas (Luke *et al.* 1991, Berry 2003, Tracy *et al.* 2004). Some of the constraints that make estimating population densities extremely difficult include the cryptic nature of the species (i.e., individuals spend much of their lives underground or concealed under shrubs), inactivity in years of low rainfall, and low abundance across a broad distribution within several different habitat types. Other factors, such as the inability to sample on private lands and rugged terrain, further complicate sampling efforts. Consequently, because of these constraints and the various methods used to estimate abundance over the years, we cannot provide concise estimations of the density of desert tortoises in each recovery unit or DWMA that have been made in a consistent manner.

Given the difficulty in determining the density of desert tortoises over large areas, differences in density estimates in the recovery plan and those derived from subsequent sampling efforts may not accurately reflect on-the-ground conditions. Regardless, the absence of live desert tortoises and presence of carcasses over large areas of some DWMA's provide at least some evidence that desert tortoise populations seem to be in a downward trend in some regions.

h. Current Threats

The majority of threats to desert tortoises and their habitats remain similar to those cited in the original listing rules and are generally associated with human land uses. Some of these threats include urbanization, unauthorized OHV activity, authorized vehicular activity, illegal collecting,

mortality on paved roads, vandalism, livestock grazing, feral burros, drought, nonnative plants and changes to natural fire regimes, and environmental contaminants. Upper respiratory tract disease and possibly other diseases were also identified as significant threats and continue to be of concern.

Urbanization and associated development is a major impact to the species and its habitat. In Nevada, most urbanization has occurred in the Las Vegas, Pahrump, Mesquite, and Coyote Springs Valley. Most urban development in Utah occurred in the vicinity of St. George. In California, urbanization and military use of the desert have resulted in significant effects to the desert tortoise. The most important urban areas for the desert tortoise in California include the Barstow, Victorville, and Twenty-Nine Palms areas. Large military bases and facilities in the Western Mojave Recovery Unit include Ft. Irwin, China Lake, Edwards Air Force Base, and the Marine Corps Air Ground Combat Center.

Recreational use on roads and trails, and large-volume, high-speed travel on major roads and highways has contributed to desert tortoise mortality; and habitat loss, degradation, and fragmentation. Many highways have been fenced to exclude tortoises which includes U.S. Highway 95 south of Las Vegas; U.S. Highway 93 north of Las Vegas; State Routes 161, 163, 164, and 165; Interstate 15 northeast of Las Vegas and in California; and Interstates 10 and 40, and Highways 58, 62, and 395 in California.

Drought has been implicated as a factor in reduced survival rates on desert tortoises in local areas (Longshore *et al.* 2003). In this 9-year study, researchers compared two “closely situated, but physiographically different, sites” in the Lake Mead National Recreation Area, Nevada. After a period during which survival rates were stable, the survival rate decreased on one of the sites that experienced drought conditions in 3 out of 4 years. The authors postulate that if such local incidents occur on a regular basis, “source-sink population dynamics may be an important factor” in determining the density of desert tortoise populations.

Proliferation of invasive plants is increasing in the Mojave and Sonoran deserts and is recognized as a significant threat to desert tortoise habitat. Many species of nonnative plants from Europe and Asia have become common to abundant in some areas, particularly where disturbance has occurred and is ongoing. As nonnative plant species become established, native perennial and annual plant species may decrease, diminish, or die out (D’Antonio and Vitousek 1992). Land managers and field scientists have identified over 116 species of nonnative plants in the Mojave and Colorado deserts (Brooks and Esque 2002).

Increased levels of atmospheric pollution and nitrogen deposition related to increased human presence and combustion of fossil fuels can cause increased levels of soil nitrogen, which in turn may result in significant changes in plant communities (Aber *et al.* 1989). Many of the nonnative annual plant taxa in the Mojave region evolved in more fertile Mediterranean regions and benefit from increased levels of soil nitrogen, which gives them a competitive edge over native annuals. Studies at three sites within the central, southern, and western Mojave Desert indicated that increased levels of soil nitrogen can increase the dominance of nonnative annual plants and promote the invasion of new species in desert regions. Furthermore, increased dominance by nonnative annuals may decrease the diversity of native annual plants, and

increased biomass of nonnative annual grasses may increase fire frequency (Brooks 2003).

Nutritional intake affects growth rates in juvenile desert tortoises (Medica *et al.* 1975) and female reproductive output (Turner *et al.* 1986, 1987; Henen 1992). Invasion of nonnative plants can affect the quality and quantity of plant foods available to desert tortoises, and thereby affect nutritional intake. Desert tortoises are generally quite selective in their choices of foods (Burge 1977; Nagy and Medica 1986; Turner *et al.* 1987; Avery 1992; Henen 1992; Jennings 1992, 1993; Esque 1992, 1994), and in some areas the preferences are clearly for native plants over the weedy nonnatives.

As native plants are displaced by nonnative invasive species in some areas of the Mojave Desert, nonnative plants can be a necessary food source for some desert tortoises. However, nonnative plants may not be as nutritious as native plants. Recent studies have shown that calcium and phosphorus availability are higher in forbs than in grasses and that desert tortoises lose phosphorus when feeding on grasses but gain phosphorus when eating forbs (Hazard *et al.* 2002). Nagy *et al.* (1998), in a comparative study on the nutritional qualities of native vs. nonnative grasses and forbs commonly consumed by desert tortoises (*Achnatherum hymenoides* [Indian ricegrass] vs. *Schismus barbatus*; *Malacothrix* spp. [desert dandelion] vs. *Erodium cicutarium*), found that the nutritional value of the two grasses was similar, but both grasses had much lower nutritional value than the forbs. This suggests that the proliferation of nonnative grasses such as *Schismus* to the exclusion of native forbs and other plants (D'Antonio and Vitousek 1992) places desert tortoises at a nutritional disadvantage. Furthermore, if desert tortoises consume just enough food to satisfy their energy needs (as commonly noted in other vertebrate groups), then the native forbs provide significantly more nitrogen and water than the nonnative forbs (Nagy *et al.* 1998).

Changes in the abundance and distribution of native plants also may affect desert tortoises in more subtle ways. In the Mojave Desert, many food plants are high in potassium (Minnich 1979), which is difficult for desert tortoises to excrete due to the lack of salt glands that are found in other reptilian herbivores such as chuckwallas (*Sauromalus obesus*) and desert iguanas (*Dipsosaurus dorsalis*) (Minnich 1970, Nagy 1972). Reptiles are also unable to produce osmotically concentrated urine, which further complicates the ability for desert tortoises to expel excess potassium (Oftedal and Allen 1996). Oftedal (2002) suggested that desert tortoises may be vulnerable to upper respiratory tract disease or other diseases due to their need to obtain sufficient water and nitrogen from food plants to counteract the negative effects of dietary potassium. Only high quality food plants (as expressed by the Potassium Excretion Potential, or PEP, index) allow substantial storage of protein (nitrogen) that is used for growth and reproduction, or to sustain the animals during drought. Nonnative, annual grasses have lower PEP indices than most native forbs (Oftedal 2002; Oftedal *et al.* 2002). Foraging studies have demonstrated that juvenile Mojave tortoises are highly selective while foraging, selecting both the plant species and plant parts that have the highest PEP value. Impacts to vegetation (such as livestock grazing, invasion of nonnative plants, and soil disturbance) that reduce the abundance and distribution of high PEP plants may result in additional challenges for foraging desert tortoises (Oftedal *et al.* 2002).”

In addition, predation by common ravens and coyotes is considered a threat that may be

increasing in severity due to the expansion of human activities into more remote locations throughout the desert or prey shifting because of prolonged drought and a lack of prey species (e.g., lagomorphs). Common raven populations in some areas of the adjacent Mojave Desert have increased 1,500 percent from 1968 to 1988 in response to expanding human use of the desert (Boarman 2002). Since ravens were scarce in the desert prior to 1940, the existing level of raven predation on juvenile desert tortoises is considered an unnatural occurrence (BLM 1990). In addition to ravens, domestic and feral dogs have emerged as significant predators of desert tortoises that occur in areas adjacent to residential development.

Global climate change is likely to affect the species' ability to recover. For example, estimates for the range of the Mojave desert tortoise suggest more frequent and/or prolonged droughts with an increase of the annual mean temperature by 5 to 7 degrees F. The greatest increases will likely occur in summer (June-July-August mean increase of as much as 9 degrees F [Christensen et al. 2007 in Service 2010]). Precipitation will likely decrease by 5 to 15 percent annually in the region, with winter precipitation decreasing up to 20 percent and summer precipitation increasing by 5 percent. Because germination of the desert tortoise's food plants is highly dependent on cool-season rains, the forage base could be reduced due to increasing temperatures and decreasing precipitation in winter. Although drought occurs fairly routinely in the Mojave Desert, extended periods of drought have the potential to affect desert tortoises and their habitats through physiological effects to individuals (i.e., stress) and limited forage availability. To place the consequences of long-term drought in perspective, Longshore et al. (2003) demonstrated that even short-term drought can result in elevated levels of mortality of desert tortoises; therefore, long-term drought is likely to have even further reaching effects, particularly given that the current fragmented nature of desert tortoise habitat (e.g., urban and agricultural development, highways, freeways, military training areas, etc.) will make recolonization of extirpated areas difficult, if not impossible.

Renewable Energy Projects

Renewable energy projects, particularly solar energy projects, have emerged as an important new threat to the desert tortoise. In an effort to properly manage the resources on public land in the southwest at a landscape level while allowing some development of solar energy projects, the BLM is preparing a Programmatic EIS. On October 27, 2011, the Supplement to the Draft Solar Programmatic EIS became available to the public for a 90-day comment period (BLM and Department of Energy 2010). The BLM's preferred alternative includes 17 solar energy zones, totaling about 285,000 acres potentially available for development within the zones. The preferred alternative also establishes a variance process that will allow development of well-sited projects outside of solar energy zones on an additional 20 million acres of public land. To date, 13 commercial-scale solar energy facilities have been approved or constructed (Table 2). Approved projects include those which have completed all actions requires by agency regulations. Additional information on the Draft Solar Programmatic EIS can be found on the internet at: <http://solareis.anl.gov/index.cfm>. For a list of all solar projects refer to website: <http://www.seia.org/galleries/pdf/Major%20Solar%20Projects.pdf>.

As discussed above, the project-by-project and cumulative effects of the renewable energy program within the range of the Mojave population of the desert tortoise have the potential to reduce the amount of available, occupied and/or suitable habitat by hundreds of thousands of

acres. The effects from utility-scale projects and impacts to habitat and population (i.e., genetic) connectivity have recently come to the forefront as a significant threat to the desert tortoise.

Table 2. Approved solar projects in desert tortoise habitat on public and private land.

Project	Acres of Desert Tortoise Habitat	Recovery Unit
Ivanpah Solar Electric Generating System- CA	3,582	Eastern Mojave
Abengoa Mojave	1,765	Western Mojave
Nevada Solar One- NV	400	Northeastern Mojave
Copper Mountain North, NV	1,400	Northeastern Mojave
Copper Mountain - NV	380	Northeastern Mojave
Silver State North- NV	2,966	Eastern Mojave
Genesis- CA	4,640	Colorado
Blythe- CA	7,025	Colorado
Blythe Energy II- CA	9,400	Colorado
Palen- CA	4,195	Colorado
Desert Sunlight- CA	4,165	Colorado
Amargosa Farm Road - NV	4,350	Eastern Mojave
Calico	4,604	Western Mojave

i. Major Actions outside the Action Area and within the Northeastern Mojave Recovery Unit

Since the 1989 listing of the desert tortoise, multiple other projects and activities have undergone section 7 consultation and subsequent approval by the BLM and other Federal agencies for livestock grazing, wild horse and burro management, flood-control, mineral material excavations, utility infrastructure, highway improvements, land disposals (from BLM to private), and OHV events. Most of these actions fall under purview of existing BLM and Federal Highway administration programmatic biological opinions. Major utility corridors on BLM land occur in the Northeastern Mojave Recovery Unit approximately parallel to U.S Highway 93 and I-15, north and northeast of Las Vegas, respectively. Major roads and highways in the recovery unit include U.S Highway 93, I-15, U.S Highway 95 (northwest of Las Vegas), State Route 168.

The western portion of the Northeastern Mojave Recovery Unit is part of the Service’s Desert National Wildlife Range. The southern and southeastern portion of the recovery unit includes portions of the Lake Mead National Recreation Area and Grand Canyon-Parashant National Monument which are managed by the National Park Service, and Red Rock Canyon National Conservation Area managed by the BLM. The Valley of Fire State Park occurs in the eastern portion of the recovery unit. With the exception of the Refuge, the National Park Service, BLM, and State Parks manage these areas for public recreation. BLM’s Nellis Dunes Special Recreation Area at the northeastern edge of the Las Vegas Valley is an open area available for public recreation which is not limited to existing roads and trails.

In addition to the solar energy project identified above (Table 2), numerous actions have occurred or undergone section 7 consultation outside the action area but within the Northeastern Mojave Recovery Unit that resulted in important effects to the desert tortoise. These actions are summarized below.

Ely District- BLM Programmatic Biological Opinion

On July 10, 2008, the Service issued a programmatic biological opinion to BLM's Ely District for future proposed projects that may result in adverse effect to the desert tortoise and its critical habitat, and four other listed species, two of which have critical habitat (File No. 84320-2008-F-0078). During the 10-year term of the biological opinion, the Service exempted incidental take of 47 desert tortoises through injury or mortality and approximately 972 tortoises captured and relocated from project sites. In addition, up to 59,375 acres of desert tortoise critical habitat and up to 109,740 acres of non-critical desert tortoise habitat could be disturbed as a result of the proposed action; 62 percent of the anticipated critical habitat disturbance and 66 percent of the non-critical habitat disturbance would occur as a result of vegetation management such as habitat improvement.

To date, no desert tortoises have been reported killed or injured; one tortoise has been moved from harm's way; and 284 acres of desert tortoise critical habitat and 142 acres of non-critical habitat have been or soon will be disturbed.

Federal Highway Administration Programmatic Biological Opinion

On September 27, 2010, the Service issued a programmatic biological opinion to the Federal Highway Administration for funding road and highway projects and use of mineral material sites for these projects over a 10-year period. The NDOT would be the primary non-Federal proponent of projects and activities under the programmatic biological opinion. The FHWA and Service anticipate that up to 4,468 acres of non-critical and 1,170 acres of critical desert tortoise habitat may be disturbed as a result of programmatic activities.

Other Major Federal Activities

On December 3, 1993, the Service issued a biological opinion to the BLM for construction of the Harry Allen Power Generating Plant. The project resulted in disturbance of 523 acres of desert tortoise habitat and the Service exempted incidental take of two desert tortoises through injury or mortality and up to 40 desert tortoises through capture and relocation from harm's way.

On September 29, 2004, the Service issued a programmatic biological opinion to the BLM for proposed activities in the Red Rock Canyon National Recreation Area west of Las Vegas. The BLM and Service anticipated that up to 5,000 acres could be disturbed and 351 desert tortoise incidentally taken during the 10-year term of the biological opinion.

On December 20, 2004, the Service issued a programmatic biological opinion to the BLM for proposed actions in the Las Vegas Valley. The BLM and Service anticipated that up to 41,484 acres could be disturbed and 1,723 desert tortoise incidentally taken within the urbanized Las Vegas Valley. This consultation will remain in effect until a comprehensive programmatic biological opinion is completed to cover all BLM activities except renewable energy projects on BLM lands in the Las Vegas District's jurisdiction.

On July 27, 2007, the Service issued a biological opinion to the Federal Aviation Administration for their proposed development of the Mesquite Regional Airport. The project would result in disturbance of 780 acres of desert tortoise habitat. The Service exempted incidental take of one desert tortoise through injury or mortality and up to 10 desert tortoises through capture and relocation from harm's way.

Large-Scale Translocation Site (LSTS)

The LSTS was established in the mid-1990s as a recipient site for desert tortoises displaced from development in Clark County, Nevada; found in harm's way and must be relocated to a secure area outside their home range; or unwanted pets. The LSTS is located near Jean, Nevada, and is bounded by State Route 161 on the north which is fenced to exclude tortoises, Interstate Highway 15 on the east, the high elevation of the Spring Mountains on the west, and a tortoise-proof fence approximately 3 miles north of the California state line on the south. The LSTS encompasses approximately 28,000 acres of public land managed by the BLM Las Vegas Field Office. Approximately 8,000 desert tortoises have been released into the LSTS since 1997.

Field et al. (1997) conducted a study on translocated desert tortoises at the LSTS. The study used 32 adult desert tortoises and 10 juvenile tortoises. In the first year, the mortality rate for translocated desert tortoise was 21.4 percent. Data suggest that drought conditions at the site rather than the translocation itself negatively affected the tortoises. None of the tortoises died during their second season at the LSTS.

g. Habitat Conservation Plans (HCPs) in the Northeastern Mojave Recovery Unit

Approximately 89 percent of Clark County consisted of public lands administered by the Federal government, thereby providing little opportunity for mitigation for the loss of desert tortoise habitat under an HCP on non-Federal lands. Alternatively, funds are collected under HCPs and spent to implement conservation and recovery actions on Federal lands as mitigation for impacts that occur on non-Federal lands. Lands managed by BLM are included in these areas where mitigation funds are used to promote recovery of the desert tortoise.

The Southeastern Lincoln County Multiple Species Habitat Conservation Plan (MSHCP) was developed by three applicants (Lincoln County, City of Caliente, and Union Pacific Railroad), BLM, and the Service. This MSHCP and associated incidental take permit exempts incidental take for the desert tortoise and southwestern willow flycatcher (*Empidonax traillii extimus*) within the 30,000-acre permit area while contributing to the conservation for these two listed species. The MSHCP will benefit the tortoise by 1) restoring habitat impacted by wildfires, 2) assisting with development and implementation of a head starting program, 3) providing funding for much needed research, 4) translocating tortoises out of harm's way, 5) fencing development areas, and 6) prohibiting the possession of pet tortoises.

On November 22, 2000, the Service issued an incidental take permit (TE-034927) to Clark County, Nevada, including cities within the County and Nevada Department of Transportation (NDOT) for actions proposed in their MSHCP. The incidental take permit allows incidental take of desert tortoise for a period of 30 years on 145,000 acres of non-Federal land in Clark County, and within NDOT rights-of-way, south of the 38th parallel in Nevada. As partial mitigation

under the MSHCP, the County purchased a conservation easement from the City of Boulder City in 1994. The term of the easement is 50 years and it will be retained in a natural condition for recovery of the desert tortoise and conservation of other species in the area. Certain uses shall be prohibited within the easement including motor vehicle activity off designated roads, livestock grazing, and any activity that is inconsistent with tortoise conservation. Much of the easement is also designated desert tortoise critical habitat. Within the boundary of the easement, Boulder City reserved the Solar Energy Zone for energy development projects in addition to adjacent energy generation facilities described previously. Nevada Solar One, Copper Mountain, and Copper Mountain North (Table 2) occur in the Solar Energy Zone.

2. Critical Habitat of the Desert Tortoise

The Service designated critical habitat for the desert tortoise in portions of California, Nevada, Arizona, and Utah in a final rule, published February 8, 1994 (59 Federal Register 5820). Critical habitat is designated by the Service to identify the key biological and physical needs of the species and key areas for recovery and to focus conservation actions on those areas. Critical habitat is composed of specific geographic areas that contain the biological and physical features essential to the species' conservation and that may require special management considerations or protection. These features, which include space, food, water, nutrition, cover, shelter, reproductive sites, and special habitats, are called the PCEs (PCEs) of critical habitat. The specific PCEs of desert tortoise critical habitat are: sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow; sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species; suitable substrates for burrowing, nesting, and overwintering; burrows, caliche caves, and other shelter sites; sufficient vegetation for shelter from temperature extremes and predators; and habitat protected from disturbance and human-caused mortality.

Critical habitat of the desert tortoise would not be able to fulfill its conservation role without each of the PCEs being functional. As examples, having a sufficient amount of forage species is not sufficient if human-caused mortality is excessive; an area with sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow would not support desert tortoises without adequate forage species.

The final rule for designation of critical habitat did not explicitly ascribe specific conservation roles or functions to the various critical habitat units. Rather, it refers to the strategy of establishing recovery units and desert wildlife management areas recommended by the recovery plan for the desert tortoise, which had been published as a draft at the time of the designation of critical habitat, to capture the "biotic and abiotic variability found in desert tortoise habitat" (59 Federal Register 5823). Specifically, we designated the critical habitat units to follow the direction provided by the 1993 draft recovery plan (Service 1993) for the establishment of desert wildlife management areas. The critical habitat units in aggregate are intended to protect the variability that occurs across the large range of the desert tortoise; the loss of any specific unit would compromise the ability of critical habitat as a whole to serve its intended function and conservation role.

Despite the fact that desert tortoises are not required to move between critical habitat units to

complete their life histories, both the original and revised recovery plans highlight the importance of these critical habitat units and connectivity between them for the recovery of the species. Specifically, the revised recovery plan states that “aggressive management as generally recommended in the 1994 Recovery Plan needs to be applied within existing (desert) tortoise conservation areas (defined as critical habitat, among other areas being managed for the conservation of desert tortoises) or other important areas ... to ensure that populations remain distributed throughout the species’ range (Desert tortoise) conservation areas capture the diversity of the Mojave population of the desert tortoise within each recovery unit, conserving the genetic breadth of the species, providing a margin of safety for the species to withstand catastrophic events, and providing potential opportunities for continued evolution and adaptive change Especially given uncertainties related to the effects of climate change on desert tortoise populations and distribution, we consider (desert) tortoise conservation areas to be the minimum baseline within which to focus our recovery efforts (pages 34 and 35, Service 2011e).”

We did not designate the Desert Tortoise Natural Area and Joshua Tree National Park in California and the Desert National Wildlife Refuge in Nevada as critical habitat because they are “primarily managed as natural ecosystems” (59 Federal Register 5825) and provide adequate protection to desert tortoises. Since the designation of critical habitat, Congress increased the size of Joshua Tree National Park and created the Mojave National Preserve. A portion of the expanded boundary of Joshua Tree National Park lies within critical habitat of the desert tortoise; portions of other critical habitat units lie within the boundaries of the Mojave National Preserve.

Within each critical habitat unit, both natural and anthropogenic factors affect the function of the PCEs of critical habitat. As an example of a natural factor, in some specific areas within the boundaries of critical habitat, such as within and adjacent to dry lakes, some of the PCEs are naturally absent because the substrate is extremely silty; desert tortoises do not normally reside in such areas. Comparing the model of desert tortoise habitat developed by Nussear et al. (2009) to the gross acreages of the critical habitat units demonstrates quantitatively that the entire area within the boundaries of critical habitat likely does not support the PCEs. As an example, Table 3 demonstrates this information; the acreage for modeled habitat is for the area in which the probability that desert tortoises are present is greater than 0.5 where 1.0 is the best habitat predicted by the model.

a. Condition of the Primary Constituent Elements of Critical Habitat

Human activities can have obvious or more subtle effects on the PCEs. The grading of an area and subsequent construction of a building removes the PCEs of critical habitat; this action has an obvious effect on critical habitat. The revised recovery plan identifies human activities such as urbanization and the proliferation of roads and highways as threats to the desert tortoise and its habitat; these threats are examples of activities that have a clear impact on the PCEs of critical habitat.

Table 3. Modeled desert tortoise habitat by critical habitat unit.

Critical Habitat Unit	Gross Acreage	Modeled Habitat Acres
Superior-Cronese (CA)	766,900	724,967

Fremont-Kramer (CA)	518,000	501,095
Ord-Rodman (CA)	253,200	184,155
Pinto Mountain (CA)	171,700	144,056
Piute-Eldorado (NV, CA)	970,600	930,008
Ivanpah Valley (CA)	632,400	510,711
Chuckwalla (CA)	1,020,600	809,319
Chemehuevi (CA)	937,400	914,505
Gold Butte-Pakoon (NV, AZ)	488,300	418,189
Mormon Mesa (NV)	427,900	407,041
Beaver Dam Slope (UT, NV, AZ)	204,600	202,499
Upper Virgin River (UT)	54,600	46,441
Total acres	6,446,200	5,792,986

We have included the following paragraphs from the revised recovery plan for the desert tortoise (Service 2011) to demonstrate that other anthropogenic factors affect the PCEs of critical habitat in more subtle ways. All references are in the revised recovery plan; we have omitted some information from the revised recovery plan where the level of detail was unnecessary for the current discussion.

Surface disturbance from off-highway vehicle activity can cause erosion and large amounts of dust to be discharged into the air. Recent studies on surface dust impacts on gas exchanges in Mojave Desert shrubs showed that plants encrusted by dust have reduced photosynthesis and decreased water-use efficiency, which may decrease primary production during seasons when photosynthesis occurs (Sharifi et al. 1997). Sharifi et al. (1997) also showed reduction in maximum leaf conductance, transpiration, and water-use efficiency due to dust. Leaf and stem temperatures were also shown to be higher in plants with leaf-surface dust. These effects may also impact desert annuals, an important food source for [desert] tortoises.

Off-highway vehicle activity can also disturb fragile cyanobacterial-lichen soil crusts, a dominant source of nitrogen in desert ecosystems (Belnap 1996). Belnap (1996) showed that anthropogenic surface disturbances may have serious implications for nitrogen budgets in cold desert ecosystems, and this may also hold true for the hot deserts that [desert] tortoises occupy. Soil crusts also appear to be an important source of water for plants, as crusts were shown to have 53 percent greater volumetric water content than bare soils during the late fall when winter annuals are becoming established (DeFalco et al. 2001). DeFalco et al. (2001) found that non-native plant species comprised greater shoot biomass on crusted soils than native species, which demonstrates their ability to exploit available nutrient and water resources. Once the soil crusts are disturbed, non-native plants may colonize, become established, and out-compete native perennial and annual plant species (DeFalco et al. 2001, D'Antonio and Vitousek 1992). Invasion of non-native plants can affect the quality and quantity of plant foods available to desert tortoises. Increased presence of invasive plants can also contribute to increased fire frequency.

Land managers and field scientists identified 116 species of non-native plants in the Mojave and Colorado deserts (Brooks and Esque 2002). Proliferation of invasive plants is increasing in the Mojave and Sonoran deserts and is recognized as a significant threat to desert tortoise habitat.

Many species of non-native plants from Europe and Asia have become common to abundant in some areas, particularly where disturbance has occurred and is ongoing. As non-native plant species become established, native perennial and annual plant species may decrease, diminish, or die out (D'Antonio and Vitousek 1992).

Increased levels of atmospheric pollution and nitrogen deposition related to increased human presence and combustion of fossil fuels can cause increased levels of soil nitrogen, which in turn may result in significant changes in plant communities (Aber et al. 1989). Many of the non-native annual plant taxa in the Mojave region evolved in more fertile Mediterranean regions and benefit from increased levels of soil nitrogen, which gives them a competitive edge over native annuals. Studies at three sites within the central, southern, and western Mojave Desert indicated that increased levels of soil nitrogen can increase the dominance of non-native annual plants and promote the invasion of new species in desert regions. Furthermore, increased dominance by non-native annuals may decrease the diversity of native annual plants, and increased biomass of non-native annual grasses may increase fire frequency (Brooks 2003).

This summary from the revised recovery plan demonstrates how the effects of human activities on habitat of the desert tortoise are interconnected. In general, surface disturbance causes increased rates of erosion and generation of dust. Increased erosion alters additional habitat outside of the area directly affected by altering the nature of the substrate, removing shrubs, and possibly destroying burrows and other shelter sites. Increased dust affects photosynthesis in the plants that provide cover and forage to desert tortoises. Disturbed substrates and increased atmospheric nitrogen enhance the likelihood that invasive species will become established and outcompete native species; the proliferation of weedy species increases the risk of large-scale fires, which further move habitat conditions away from those that are favorable to desert tortoises. The following paragraphs generally describe how the PCEs are affected by the threats described in the revised recovery plan.

PCE 1: Sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow. Urban and agricultural development, concentrated use by off-road vehicles, and other activities of this nature completely remove habitat. Although we are aware of local areas within the boundaries of critical habitat that have been heavily disturbed by the unauthorized use of such activities, we do not know of any areas that have been disturbed to the intensity and extent that this PCE has been compromised. To date, the largest losses of critical habitat are likely the result of the widening of existing freeways. Despite these losses of critical habitat, which occur in a linear manner, the critical habitat units continue to support sufficient space to support viable populations within each of the five recovery units.

In some cases, major roads likely disrupt the movement, dispersal, and gene flow of desert tortoises. Highways 58 and 395 in the Fremont-Kramer Critical Habitat Unit; U.S Highway 95 in the Piute-Eldorado Critical Habitat Unit; and Fort Irwin Road in the Superior-Cronese Critical Habitat Unit are examples of large and heavily travelled roads that likely disrupt movement, dispersal, and gene flow. Roads that have been fenced and provided with underpasses may alleviate this fragmentation to some degree; however, such facilities have not been in place for sufficient time to determine whether they would eliminate this effect.

The threats of invasive plant species described in the revised recovery plan generally do not result in the removal of this PCE because they do not convert habitat into impervious surfaces, such as urban development would.

PCE 2: Sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species. This PCE addresses the ability of critical habitat to provide adequate nutrition to desert tortoises. As described in the revised recovery plan and 5-year review, grazing, historical fire, invasive plants, altered hydrology, drought, wildfire potential, fugitive dust, and climate change/temperature extremes contribute to the stress of “nutritional compromise.” Paved and unpaved roads through critical habitat of the desert tortoise provide avenues by which invasive native species disperse; these legal routes also provide the means by which unauthorized use occurs over large areas of critical habitat. Nitrogen deposition from atmospheric pollution likely occurs throughout all of the critical habitat units and exacerbates the effects of the disturbance of substrates. Because paved and unpaved roads are so widespread through critical habitat, we expect that this threat has, to some degree, compromised the conservation value and function of critical habitat throughout the range of the desert tortoise.

PCE 3: Suitable substrates for burrowing, nesting, and overwintering. Surface disturbance, motor vehicles traveling off route, use of off-highway vehicle management areas, off-highway vehicle events, unpaved roads, grazing, historical fire, wildfire potential, altered hydrology, and climate change leading to shifts in habitat composition and location, storms, and flooding can alter substrates to the extent that they are no longer suitable for burrowing, nesting, and overwintering; erosion caused by these activities can alter washes to the extent that desert tortoise burrows placed along the edge of a wash, which is a preferred location for burrows, could be destroyed. We expect that the area within critical habitat that is affected by off-road vehicle use to the extent that substrates are no longer suitable is relatively small in relation to the area that desert tortoises have available for burrowing, nesting, and overwintering; consequently, we expect that off-road vehicle use does not have a substantial effect on this PCE.

Most livestock allotments have been eliminated from within the boundaries of critical habitat. Additionally, we expect that livestock would compact substrates to the extent that they would become unsuitable for burrowing, nesting, and overwintering only in areas of concentrated use, such as around watering areas and corrals. Because livestock grazing occurs over a relatively small portion of critical habitat and the substrates in most areas within livestock allotments would not be substantially affected, we expect that suitable substrates for burrowing, nesting, and overwintering remain throughout most of the critical habitat units.

PCE 4: Burrows, caliche caves, and other shelter sites. We expect that human-caused effects to burrows, caliche caves, and other shelter sites likely occur at a similar rate as effects to substrates for burrowing, nesting, and overwintering for the same general reasons. Consequently, we expect that sufficient burrows, caliche caves, and other shelter sites remain throughout most of the critical habitat units.

PCE 5: Sufficient vegetation for shelter from temperature extremes and predators. In general, sufficient vegetation for shelter from temperature extremes and predators remains throughout

critical habitat. In areas where large fires have occurred in critical habitat, many of the shrubs that provide shelter from temperature extremes and predators have been destroyed; in such areas, cover sites may be a limiting factor. The proliferation of invasive plants poses a threat to shrub cover throughout critical habitat as the potential for larger wildfires increases.

In 2005, wildfires in Nevada, Utah, and Arizona burned extensive areas of critical habitat (Table 4). The revised recovery plan notes that the fires caused statistically significant losses of perennial plant cover, although patches of unburned shrubs remained. Given the patchiness with which the PCEs of critical habitat are distributed across the critical habitat units and the varying intensity of the wildfires, we cannot quantify precisely the extent to which these fires disrupted the function and value of the critical habitat.

Table 4. Areas burned by wildfires in 2005

Critical Habitat Unit	Total Area Burned (acres)	Percent of the Critical Habitat Unit Burned
Beaver Dam Slope	53,528	26
Gold-Butte Pakoon	65,339	13
Mormon Mesa	12,952	3
Upper Virgin River	10,557	19

PCE 6: Habitat protected from disturbance and human-caused mortality. In general, the Federal agencies that manage lands within the boundaries of critical habitat have adopted land management plans that include implementation of some or all of the recommendations contained in the original recovery plan for the desert tortoise. To at least some degree, the adoption of these plans has resulted in the implementation of management actions that are likely to reduce the disturbance and human-caused mortality of desert tortoises. For example, these plans resulted in the designation of open routes of travel and the legal closure (and, in some cases, physical closure) of unauthorized routes. Numerous livestock allotments have been relinquished by the permittees and retired by the BLM and National Park Service. As a result of planning efforts, the BLM’s record of decision included direction to withdraw areas of critical habitat from mineral entry. As a result of actions on the part of various agencies, many miles of highways and other paved roads have been fenced to prevent desert tortoises from wandering into traffic and being killed. The Service and other agencies of the Desert Managers Group in California are implementing a plan to remove common ravens that prey on desert tortoises and to undertake other actions that would reduce subsidies (i.e., food, water, sites for nesting, roosting, and perching, etc.) that facilitate their abundance in the California desert.

Despite the implementation of these actions, disturbance and human-caused mortality continue to occur in many areas of critical habitat (which overlap the desert wildlife management areas to a large degree and are the management units for which most data are collected) to the extent that the conservation value and function of critical habitat is, to some degree, compromised. For example, many highways and other paved roads in California remain unfenced. Twelve desert tortoises were reported to be killed on paved roads from within Mojave National Preserve in 2011; we fully expect that desert tortoises are being killed at similar rates on many other roads, although these occurrences are not discovered and reported as diligently as by the National Park

Service.

Unauthorized off-road vehicle use continues to disturb habitat and result in cleared areas within the boundaries of critical habitat in California (e.g., Coolgardie Mesa in the Western Mojave Recovery Unit); although we have not documented the death of desert tortoises as a result of this activity, it likely occurs. Additionally, the habitat disturbance caused by this illegal activity exacerbates the spread of invasive plants, which displace native plants that are important forage for the desert tortoise, thereby increasing the physiological stress faced by desert tortoises.

Finally, the BLM has not allowed the development of solar power plants within the boundaries of its ACECs. Conversely, it is considering the approval of at least one wind energy facility within critical habitat; the County of San Bernardino is also circulating planning documents for the construction and operation of at least two such facilities within the boundaries of the Superior-Cronese Critical Habitat Unit.

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