Flat-tailed Horned Lizard Rangewide Management Strategy, 2003 Revision

An Arizona-California Conservation Strategy

Prepared and edited by the

Flat-tailed Horned Lizard Interagency Coordinating Committee
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EXECUTIVE SUMMARY

The Flat-tailed Horned Lizard Rangewide Management Strategy has been prepared to provide guidance for the conservation and management of sufficient habitat to maintain extant populations of flat-tailed horned lizards (FTHLS), *Phrynosoma mcallii,* in each of five Management Areas (MAS) in perpetuity. The species is found only in southwestern Arizona, southeastern California, and adjacent portions of Sonora and Baja California Norte, Mexico.

The USFWS proposed the species for listing as a threatened species on November 29, 1993. Human activities have resulted in the conversion of roughly 49% of the historic FTHL habitat to other uses, such as agriculture and urban development. Further evaluation of populations supported by remaining habitat is necessary. While initial evidence suggested that FTHL populations had declined in the Yuha Basin and northern East Mesa (Wright 1993; USFWS 1993), Wright (2002) recently found no significant trends in lizard encounter rates in Yuha Desert, East Mesa, or West Mesa from 1979-2001. The USFWS withdrew its proposed listing on January 3, 2003, based in part on protections offered by this Rangewide Management Strategy (RMS).

The 1997 edition of the RMS established five FTHL MAS — four in California and one in Arizona. Surface disturbing activities are limited in these areas. Although land alterations in FTHL habitat outside of the MAS are not limited, mitigation and compensation measures are applied. One research area (RA) was also established to support research in an active off-highway vehicle (OHV) recreation area. Conservation areas in the Coachella Valley were also established.

Wide-scale population estimates have, to date, been unreliable. While new techniques to estimate abundance continue to be evaluated, this revised document calls for monitoring changes in distribution over time in addition to monitoring changes in population size. Revised monitoring techniques have been established.

The RMS was prepared by representatives from federal, state, and local governments. Itis designed to be used as the basis for a conservation agreement among the agencies. Signatory agencies will incorporate measures in the RMS into their land management plans. Compliance with the National Environmental Policy Act (NEPA) and other applicable federal and state law will be achieved through these management plans or revisions. The planned actions in the RMS are organized in a step-down format used by the USFWS in recovery plans.

PREFACE

Dr. Larry D. Foreman and members of the Flat-tailed Horned Lizard Interagency Coordinating Committee (ICC) prepared the original *Flat-tailed Horned Lizard Rangewide Management Strategy* in 1997. Kevin V. Young[1] and Ty J. Gardner coordinated the 2003 revision (Arizona Game and Fish Department solicitation # QF02-040-S; funds made available by the U.S. Fish and Wildlife Service). The following members of the ICC and MOG (listed by agency) participated in writing and discussion until a consensus was reached:

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Cover Artwork: flat-tailed horned lizard in Sonora, Mexico. Courtesy of Jim Rorabaugh.

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LIST OF ACRONYMS

The following acronyms are used in this document:

ACEC.....Area of Critical Environmental Concern

AGFD .....Arizona Game and Fish Department

ABDSP .....Anza-Borrego Desert State Park

BLM .....United States Bureau of Land Management

BMGR .....Barry M. Goldwater Range

BOR.....United States Bureau of Reclamation

BP .....Border Patrol

CDFG.....California Department of Fish and Game

CNLM .....Center for Natural Lands Management

CVMSHCP.....Coachella Valley Multiple Species Habitat Conservation Plan and Natural Communities Conservation Plan

DOD .....United States Department of Defense

EA.....Environmental Assessment

FTHL .....Flat-tailed horned lizard

GIS .....Geographic Information System

ICC.....Interagency Coordinating Committee

MA .....Management Area

MCAS .....Marine Corps Air Station, Yuma

MOG.....Management Oversight Group

MOU.....Memorandum of Understanding

NAF.....Naval Air Facility

NEPA.....National Environmental Policy Act

OHV .....Off-highway vehicle

OWSVRA.....Ocotillo Wells State Vehicular Recreation Area

RA.....Research Area

ROW.....Right of Way

SVL .....Snout-Vent Length

USFWS.....United States Fish and Wildlife Service

OVERVIEW

Species Description

Taxonomy

The flat-tailed horned lizard (FTHL), *Phrynosoma mcallii*, was first described by Hallowell in 1852 as *Anota mcallii* after U.S. Army Colonel George A. M'Call who collected the type specimen (Johnson and Spicer 1985). Due to the lack of external ear openings, the FTHL was initially placed in a separate genus (*Anota*) from other horned lizards (Johnson and Spicer 1985). Norris and Lowe (1951) decided that similarities of *mcallii* to other horned lizards were greater than its differences and placed it into the genus *Phrynosoma*. The FTHL is one of 14 currently recognized species of horned lizard (eight of which occur in the U.S.) (Zamudio and Parra Olea 2000). It is believed to be most closely related to the desert horned lizard, *P. platyrhinos* (Reeder and Montanucci 2001). No subspecies of FTHL have been described (Funk 1981).

Field Characters

The FTHL has the typical round, flattened body shape of horned lizards. It is distinguished from other species in its genus by its dark vertebral stripe; lack of external ear openings; long, broad and flattened tail; and comparatively long spines on the head (Funk 1981). The FTHL has two rows of fringed scales on each side of its body. The species is cryptic in color, ranging from pale gray to light rust brown dorsally, and white or cream (unspotted) ventrally with a prominent umbilical scar. The only apparent external difference between males and females is the presence of enlarged postanal scales in males, typical of Phrynosomatids. Maximum snout-vent length (SVL) for the species is 87 mm (Boundy and Balgooyen 1988), but 65-80 mm SVL is typical adult size (Young and Young 2000). Adult weight varies between 10 and 25 g. Hatchlings range from 30 to 38 mm and weigh about 1.5 g (Johnson and Spicer 1985; Young and Young 2000).

The only other horned lizard known to be sympatric with the FTHL is the desert horned lizard. The latter is distinguished from the FTHL by a combination of characters including absence of a dark vertebral stripe, an exposed tympanum, a spotted ventral surface in most individuals, a single row of fringed scales, and a narrower and less-flattened tail (Figure 1). Apparent hybrids between the two species, which exhibit a mix of morphological characteristics, have been observed near Ocotillo, California (Stebbins 1985) and on the BMGR near Yuma, AZ (Morrill, Young, pers. obs.). There has been at least one case of hybridization in captivity (Collet 2002).

Figure 1. Comparative views of *Phrynosoma mcallii (left)* and *P. platyrhinos* (right) adults and hatchlings.

Distribution and Habitat Status

The FTHL has the most limited distribution of any horned lizard species in the U.S. (Stebbins 1985). It is found in the extreme southwestern corner of Arizona, the southeastern corner of California, and adjoining portions of Sonora and Baja California, Mexico (Figure 2). In Arizona, the FTHL is found in southwestern Yuma County south of the Gila River and west of the Butler and Gila mountains. Estimates of historic habitat in Arizona range from 203,520 to 221,043 acres, and of current habitat from 135,900 to 176,000 acres (Johnson and Spicer 1985; Rorabaugh *et al*. 1987; Hodges 1995, 1997; Piest and Knowles 2002). Suitable habitat is found east and south of the city of Yuma outside of the Colorado and Gila River floodplains and adjoining croplands. Lands within the range of the FTHL in Arizona include federal lands administered by the Department of Defense (DOD) through Marine Corps Air Station at Yuma (MCAS-Yuma), the Bureau of Land Management (BLM), and the Bureau of Reclamation (BOR); state of Arizona lands; and private lands. The majority of the FTHL's range in Arizona is on the western Barry M. Goldwater Range (BMGR), managed by MCAS-Yuma. Records from Mexico Highway 2, just south of the International Boundary, suggest the species might be present in the area of Pinta Sands on the Cabeza Prieta National Wildlife Refuge, but searches in this area have only documented desert horned lizards (Rorabaugh 1996a, 1997).

The historical range of the FTHL in California encompasses approximately 1.8 to 2.2 million acres, primarily in Imperial County, but also in eastern San Diego County and central Riverside County (Turner *et al.* 1980; Rado 1981; Bolster and Nicol 1989; Hodges 1997). However, about 50% of the land within this range is now unsuitable, including the Salton Sea and urban and agricultural areas (Hodges 1997). Areas identified as especially important to the species in California encompass approximately 210,000 acres and are found primarily in four regions (Rado 1981; Turner *et al.* 1980). MAs were established in these areas and have been the focus of FTHL habitat conservation (see Management Areas, p. 49). The El Centro Resource Area (BLM, California Desert District) administers three of these areas: West Mesa MA, East Mesa MA, and Yuha Desert MA (the BLM and the U.S. Navy jointly manage portions of West Mesa and East Mesa). The California Department of Parks and Recreation (CDPR) manages Ocotillo Wells State Off-Highway Vehicle Area (OWSVRA) as a RA and a portion of Anza-Borrego Desert State Park (ABDSP) as the Borrego Badlands MA.

The northern margin of the species' range is in the Coachella Valley, an area where expansive agricultural and urban development has destroyed the vast majority of original FTHL habitat. The largest remaining, unfragmented habitat patch is approximately 3,900-4,200 acres in size, just 3-4% of the original habitat extent within the Coachella Valley (Barrows 2002). The Coachella Valley Multiple Species Habitat Conservation Plan and Natural Communities Conservation Plan (CVMSHCP) will protect approximately 44.5% of the remaining FTHL habitat in the valley.

Based on Figure 2, about half of the historical range of the FTHL is in Mexico, particularly in Sonora. In Baja California Norte, the range extends from the International Border west of Mexicali south to Laguna Salada. A specimen found south of Laguna Salada in 2001 (Rodriguez 2002) extended the known southern range limit in Baja by approximately 40 miles. It is unknown whether this population is connected to those to the north or is disjunctive. In Sonora, the species has been found in the sandy plains immediately south of and contiguous with habitat in Arizona, and east through the Pinacate Region to the sandy plains around Puerto Peñasco and Bahía de San Jorge (Johnson and Spicer 1985; Gonzáles-Romero and Álvarez-Cárdenas 1989; Rodríguez 2002). The FTHL is probably absent from the volcanic areas in the Pinacate Region and rare in the dune fields of the Gran Desierto (Rodríguez 2002).

Map Creation

The current and historical distribution map (Figure 2) is designed to provide graphic representation of the approximate current and historical FTHL range boundaries. This map is not based on a predictive model, with the exception of the current range in the Coachella Valley (see below), and should not be viewed as such. ArcView (ESRI 1998) shape files (.shp) for the current and historical distributions recognized in this document are on file with ICC member agencies.

The historical distribution is based on a 750-foot contour interval across the majority of the range, particularly in the U.S. and the most northern portion of Mexico. There are several departures from this contour: 1) along the eastern boundary of the Algodones dune system the boundary is based on a microphyll/desert dry wash habitat (coverage provided by BLM-El Centro) because the habitats to the east of these are not likely to have been occupied by FTHLS at any time (contra Hodges 1997); 2) the boundary on the eastern side of the Yuma desert MA was defined as the edge of the rocky substrate, estimated as a fixed distance from the western slope of the Gila mountains,

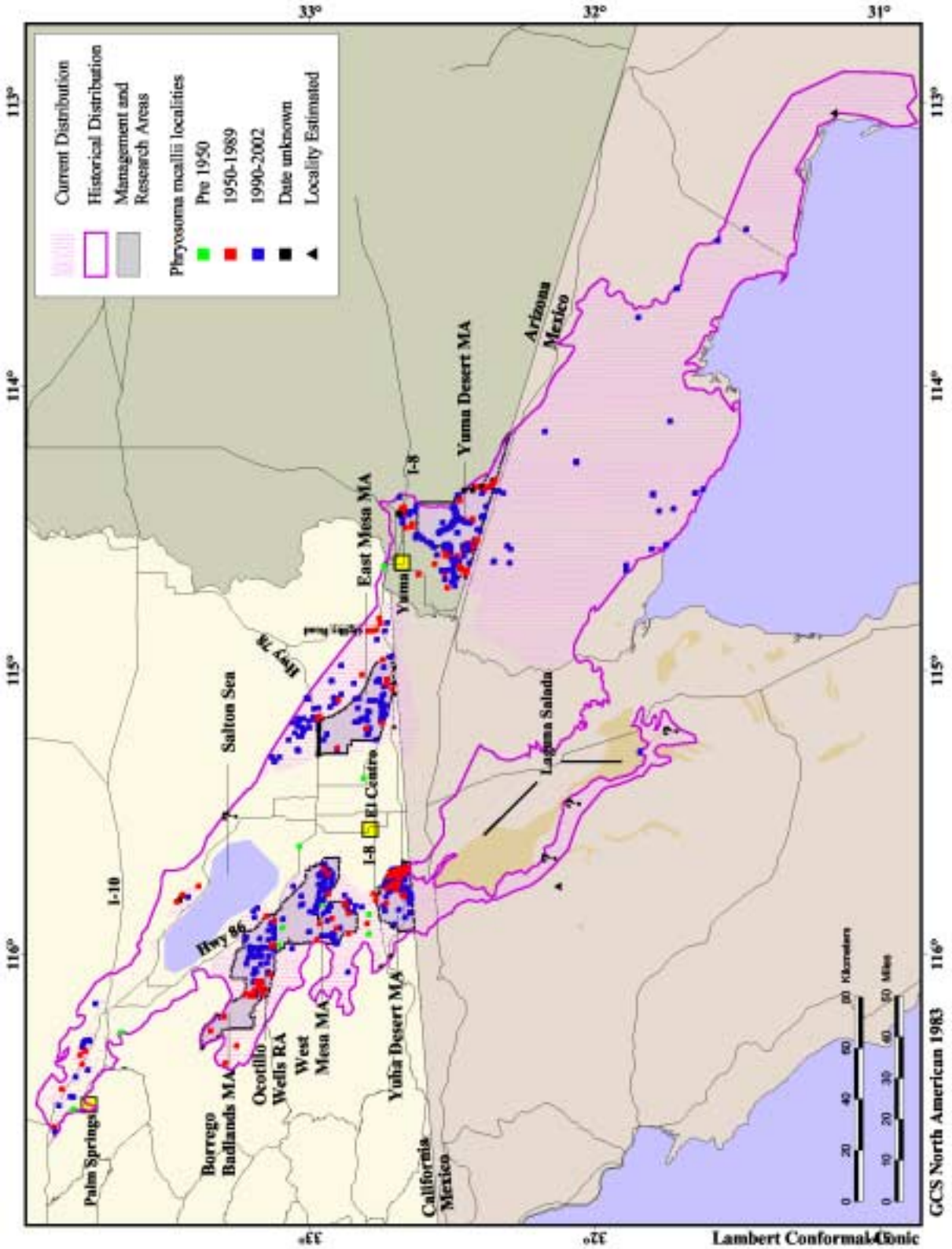
since this habitat is not occupied by FTHLs (Hodges 1995, Young and Young 2000); 3) much of the range in Sonora, Mexico is based on an ArcView coverage (obtained from http://data.geocomm.com) that delineates the boundaries between unconsolidated substrates (included) and inundated areas (excluded), but areas outside the unconsolidated substrates were included (e.g. mudhill habitat near El Golfo) where verified locality data were available (Rodríguez 2002); and 4) the distribution around Laguna Salada is based on the range map in Foreman (1997), recent localities (Rodríguez 2002) and mention of sightings on the eastern side where sand accumulates against the Sierra Cucapa (Lee Grismer, California State University San Diego, pers. comm.).

The current distribution (except the Palm Springs area) is a subset of the historical range map from which habitat that has been converted to urban, agricultural, or other such permanent disturbances has been removed. Data used to remove such areas include USGS maps, ArcView coverages of city streets, and aerial photographs of the East Mesa, West Mesa, and Yuha Desert MAs and surrounding areas (provided by BLM-El Centro). Features removed include, but are not limited to: Yuma, AZ; Ocotillo, Borrego Springs, and Salton City, California; the agricultural areas of the Imperial Valley, California and the Mexicali Valley, Baja Norte; and projects recognized on aerial photos in the Yuha Desert MA, north of the Yuha Desert MA, and near the Salton Sea Test Base.

The current distribution in the Coachella Valley area (Riverside Co., California) is the October 2002 draft (provided by the Coachella Valley Association of Governments) of the predicted portion of a FTHL habitat model produced for the CVMSHCP. This model includes habitat below the 700-foot contour interval. The model was refined by looking for vegetation community and soil type associations and deleting developed areas. The model includes habitat patches that are too small to maintain viable populations (Cameron Barrows, Center for Natural Lands Management (CNLM), pers. comm.). Further information is available through the Coachella Valley Association of Governments.

Further work is necessary to solidify the current distribution of the FTHL in the U.S. and Mexico. In particular, work is needed outside the MAs to firmly delineate the boundaries on the exterior portion of the range in the U.S. Such work, in conjunction with surveys within MAs, could help produce a habitat model that may more accurately describe the historical and current FTHL range. Areas of Mexico that remain uncertain and could benefit from further surveys and/or modeling include: 1) the southeast boundary in Sonora; 2) the extent of historical range in the Mexicali valley and the current range surrounding that area (including Mesa Andrade); 3) the extent of the current and historical ranges surrounding Laguna Salada; and 4) the degree of connectivity between portions of the current and historical ranges in Sonora, the Mexicali Valley, and surrounding Laguna Salada.

Figure 2. Approximate current and historical distribution of the flat-tailed horned lizard.



Habitat Use

Flat-tailed horned lizards occur entirely within the Lower Colorado River Valley Subdivision of Sonoran Desert Scrub (Turner and Brown 1982), the largest and most arid subdivision of the Sonoran Desert. Annual precipitation varies from 5.8 cm at El Centro, California to 13.5 cm at Palm Springs. Summer daytime temperatures range from 30 to 45°C.

Most records for FTHLs come from the creosote (*Larrea tridentata*)-white bursage (*Ambrosia dumosa*) series of Sonoran Desert Scrub (Turner and Brown 1982). It is this open community in association with sandy flats and valleys that is often described as FTHL habitat (Stebbins 1985; Turner and Medica 1982; Rorabaugh *et al.* 1987). Although most records for the species are from sandy flats or areas with a veneer of fine, windblown sand, the FTHL has also been collected or observed in areas with little or no windblown sand, such as badlands in the Yuha Basin and the Borrego Valley, and on saltbush flats at the northeastern end of the Salton Sea (Turner *et al.* 1980; Wone and Beauchamp 1995a). The species has also been recorded in the mixed scrub series within the Lower Colorado River Valley Subdivision of Sonoran Desert Scrub (Turner and Brown 1982), on gravelly soils in ABDSP, and in association with senita cactus (*Lophocereus schottii*) in Sonora. FTHLs apparently occur at low densities in parts of the Algodones dune fields (Luckenbach and Bury 1983; Wright, pers. obs.) and are probably rare in the unvegetated portions of other major dune systems (Luckenbach and Bury 1983; McCalvin 1993; Rodríguez 2002; Turner *et al.* 1980).

In California, the species has been recorded in a comparatively broad range of habitats, including sandy flats and hills, badlands, salt flats, and gravelly soils. In Arizona, the species is apparently restricted to sandy and hardpan flats. This may be due to habitat availability rather than FTHL habitat preferences. In Arizona, the presence of big galleta grass (*Pleuraphis rigida*) was correlated with FTHL abundance and may be an important vegetation component of its habitat (Rorabaugh *et al.* 1987). However, big galleta grass is not present in many high-density FTHL areas in California (Turner and Medica 1982; Rorabaugh *et al.* 1987). In California, Muth and Fisher (1992) found both white bursage (*Ambrosia dumosa*) and indigo bush (*Dalea emoryi*) were correlated with FTHLs, presumably because of their ability to trap wind-blown sand and provide shade for thermal cover. In the badlands habitat at OWSVRA, FTHL commonly use rocks as basking sites and for cover, primarily along the ridges of the hills (Setser 2001). In the Coachella Valley, FTHL are found in high densities in areas with saltbush (*Atriplex canescens* and *A. polycarpa*). The saltbush consistently produces seeds each fall, even in drought conditions, which may account for elevated ant populations and higher FTHL densities in this habitat (Cameron Barrows, CNLM, pers. comm.). A sampling of FTHL habitats is shown in Figure 3.

Although the desert horned lizard occurs sympatrically with the FTHL, subtle differences have been described in preferred microhabitat use by both species in close proximity. Rorabaugh *et al.* (1987) characterized desert horned lizard habitat as gently sloping alluvial terrain dominated by washes vegetated with small trees such as palo verde (*Parkinsonia microphylla*) and ironwood (*Olneya tesota*). FTHL habitat in the near proximity was described as consisting of finer sand, more level and unbroken terrain, and sparser creosotebush-bursage vegetation than the habitat of the desert horned lizard (Hodges 1995; Young and Young 2000).

Figure 3. Typical flat-tailed horned lizard habitat from various parts of its range.

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a) Yuma Desert MA

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b) Coachella Valley Preserve

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c) East Mesa MA

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d) Ocotillo Wells RA

Food Habits

Ants constituted 97% of the prey items in FTHL stomachs examined by Pianka and Parker (1975) and scats examined by Turner and Medica (1982). The percentage of ants in their diet is greater than other horned lizards (Pianka and Parker 1975). Harvester ants (in the genera *Messor* and *Pogonomyrmex*) are far more important in the diet than smaller ant species (Turner and Medica 1982), and *Pogonomyrmex* are twice as common as *Messor* in the scats of FTHL on the Yuma Desert MA, AZ (Young and Young 2000). Studies in California (Turner and Medica 1982) and Arizona (Turner and Medica 1982; Rorabaugh *et al.* 1987) showed positive correlations between FTHL scat abundance and number of harvester ant nests.

While FTHLs feed almost exclusively on ants from day to day, occasional outbreaks of other insects may provide important feeding opportunities. For example, Mark Fisher (Boyd Deep Canyon Desert Research Center, pers. comm.) observed FTHLs gorging on sphinx moth larvae. Young (unpubl. data) examined the stomach of one road-killed FTHL and found it full of small beetles, which at the time were very abundant. Piest (pers. obs.) observed several instances in one morning where FTHLs were feeding at termite casings. While such feeding opportunities are short-lived, they may allow for quick building of fat reserves.

Like other carnivorous desert lizards, FTHLs primarily use preformed water (water found in their food) to maintain proper water balance (Schmidt-Nielsen 1964). Freestanding water is not usually available in FTHL habitat. Dew, which is used as a water source by lizards in other climates, is uncommon in southwestern deserts. It normally occurs at cool temperatures and evaporates before lizards become active enough to use it (Schmidt-Nielsen 1964). The use of free water by FTHLs is debatable. Mayhew (1968) states that FTHLs have never been seen drinking water in the wild or in captivity. However, Johnson and Spicer (1985) and Young (pers. obs.) witnessed captive FTHLs drinking water that was sprayed on their heads.

Reproduction

Flat-tailed horned lizards are oviparous (egg-laying) and early maturing, and they can produce multiple clutches (Howard 1974). Under favorable conditions, two cohorts of hatchlings may be produced in late July and in September (Muth and Fisher 1992), but in dry conditions only the late season clutch may be produced (Young and Young 2000). Hatchlings from the first cohort in July may reach sexual maturity after their first winter season, whereas hatchlings born later may require an additional growing season to mature (Howard 1974).

Compared to most other horned lizards, FTHLs produce relatively small clutches, ranging from 3 to 7 eggs with a mean clutch size of about 5 (Howard 1974; Pianka and Parker 1975). Howard (1974) developed a productivity index as a product of the number of egg clutches per year and the average number of eggs per clutch. The FTHL productivity ranked the lowest among the horned lizards studied, followed by the desert horned lizard. Howard (1974) suspected that very high temperatures and high aridity experienced by both species resulted in their lower reproductive potential. High aridity may also pose problems for nest construction. In 2000, two nest sites were found at OWSVRA, at depths of 14 cm and 26 cm, both times a few centimeters deeper than the point at which the substrate became visibly moist (Setser 2001). Two nest sites were also found on the Yuma Desert MA in drier weather conditions. One was at a depth of 90 cm and the other was at a depth of 80 cm. Again, the nest sites were a few centimeters below the level at which the

sand became visibly moist (Young and Young 2000). An even sex ratio was documented in populations in California (Turner and Medica 1982; Muth and Fisher 1992).

Behavior

Unlike other iguanid lizards, which often flee when approached, FTHLs generally remain still (Wone and Beauchamp 1995a), or may bury themselves in loose sand (Norris 1949; Young and Young 2000). This reluctance to move when disturbed, together with cryptic coloration and flattening of the body, makes them very difficult to locate in the field and very susceptible to road mortality.

FTHLs studied by Muth and Fisher (1992) spent 54% of the day in some form of movement. Most activity occurred throughout the mid-day in spring and fall. As summer temperatures increase, FTHLs shift to two activity periods, morning and evening (Mayhew 1968).

During the active season, FTHLs most often spend the night exposed on the surface, but occasionally shuffle under the sand or enter a burrow (Klauber 1939; Smith 1946; Muth and Fisher 1992; Young and Young 2000). When daytime surface temperatures approach 120°F (50°C), individuals retreat into burrows, at least some of which are of their own making (Rorabaugh 1994), but do not exhibit summer dormancy, even during drought conditions (Young and Young 2000). In Arizona, these daytime burrows were found to be straight, 70-80 cm long, and 25-30 cm deep (Young and Young 2000). The availability of burrows, or soils friable enough for burrow construction, may be a necessary habitat component for FTHLs (Muth and Fisher 1992; Rorabaugh 1994).

Muth and Fisher (1992) reported winter dormancy for FTHLs from mid-November until mid-February, but Setser (2001) noted some animals becoming dormant in mid-October. Mayhew (1965) found the majority of adult FTHLs hibernated in burrows they had dug within 5 cm of the surface. All winter-dormant FTHLs found by Muth and Fisher (1992) were within 10 cm of the surface. According to Mayhew (1968), adult FTHLs are obligatory hibernators. He suspected that reduced food availability, as well as decreasing photoperiod and lower metabolic rate resulting from reduced temperature, is the hibernation triggering mechanism (Mayhew 1965). In his study of FTHL in the lab, adults ceased eating in the fall regardless of temperature and starved when prevented from hibernating. However, horned lizards are notoriously difficult to keep in captivity, and the starvation may have been unrelated to the need to hibernate. Hollenbeck (pers. obs.) has observed some adult FTHLs at OWSVRA active for several weeks at a time during the winter. Sherbrooke (1987) successfully raised regal horned lizards (*Phrynosoma solare*) without hibernation.

Juveniles have often been found to show winter activity in California (Muth and Fisher 1992; Cameron Barrows, CNLM, pers. comm.). Whereas adults may be able to make metabolic adjustments for hibernation, juveniles may have to remain active so their fat reserves can be supplemented throughout winter (Muth and Fisher 1992). The smaller body size of the juveniles would allow them to reach a preferred body temperature on warm winter days quicker than the larger adults (Schmidt-Nielsen 1964), and winter activity may allow juveniles to reach reproductive maturity at an earlier age (Howard 1974; Smith and Ballinger 1994).

FTHLs have unusually large home ranges for lizards their size. Allometric equations based on lizard mass would predict FTHL home ranges to be less than 0.5 acres. But at Muth and Fisher's

West Mesa study site, the mean home range size for all FTHLs with more than 18 recaptures was 6.7 acres. (Muth and Fisher 1992). At a site in the Yuha Desert, Turner and Medica (1982) estimated home ranges of 0.32 and 0.12 acres for male and female FTHLs, respectively. However, the small size of the Yuha Desert study plot (10.1 acres) combined with relatively few recaptures and a relatively short study period likely resulted in an underestimate of home range size. On the Yuma Desert MA, among 14 FTHLs that were each relocated at least 45 times over the course of the summer, the mean home range of male FTHLs was 8.8 acres. Females had a significantly smaller mean home range of 4.37 acres (Miller 1999). However, using only 10-15 locations of 45 FTHLs over 15-day time periods changed the mean home range estimate to only 0.84 acres (Miller 1999). This suggests that FTHLs in that population may not maintain distinct home ranges, but instead shift their area of use through time, thereby increasing the home range estimate with each additional location. Great variation in home range size was noted among individuals and between years (Miller 1999; Young and Young 2000). Young and Young (2000) found that in the Yuma Desert MA, FTHL home range size decreased in females during a wet year, presumably because they did not have to forage as widely to meet energetic demands. Conversely, males increased their movements in the wet year, presumably because the abundant resources allowed them to increase mate-seeking behavior. At OWSVRA, home ranges appear more stable than in the Yuma Desert MA (Setser 2001).

Population Dynamics

No definitive data exist on population dynamics. However, information from scat surveys (Rorabaugh 1994; Wright 2002) and life history studies (Muth and Fisher 1992; Young and Young 2000) suggest that densities fluctuate greatly between years and that these fluctuations may be associated with winter/spring precipitation and production of annual plants in the spring. This pattern is true for other desert lizards (see Mayhew 1967; Hoddenbach and Turner 1968; Parker and Pianka 1975). Because scat size and scat production are greatly affected by climatic conditions, scat counts may exaggerate true population dynamics (Young and Young 2000).

FTHL populations may fluctuate in response to prey availability. Harvester ant population sizes and activity fluctuate with the availability of seeds, which are correlated with the amount and timing of precipitation (Beatley 1967; Brown *et al.* 1979). Harvester ants rely on seed storage during periods of climatic stress, thus decreasing their availability as a food source for FTHLs during periods of low precipitation (Brown *et al.* 1979). In the Yuma Desert MA, it is uncommon for individual FTHLs to live more than four years, but a lifespan of at least six years has been recorded (Young, unpublished data). Mortality due to predation varies greatly from year to year (Young and Young 2000). Predation rates may also vary between habitat types, with higher yearly survivorship noted at OWSVRA than in the Yuma Desert MA (Setser 2001).

Population Viability Analysis

A FTHL Conservation Team conducted population viability analyses with the simulation models RAMAS and VORTEX (Fisher *et al.* 1998). The Team's work clarified research needs and provided some insight into the mechanisms of FTHL population dynamics. Population variables such as age-specific survivorship, fecundity, and population size; sex ratios; age at first reproduction; density dependence; stochasticity; and other variables were used in the analysis to generate information about population viability, especially extinction risk for specified time intervals.

Ideally, these analyses would define an initial population size and reserve size needed to support a viable population for a specified time interval, such as 100 or 500 years. Unfortunately, population demographics and stochasticity in possible reserves (MAS) are not adequately understood to provide this information. Generally for vertebrates, populations above 5,000 individuals are considered viable (Meffe and Carroll 1994). The goal of estimating minimum viable populations is not to maintain the *minimum* number, but to maintain populations well above that size. Each of the MAS is believed to contain viable FTHL populations.

The simulation models suggested that FTHL population viability is particularly sensitive to changes in mortality rates versus other factors. This likely explains the absence of FTHL near agricultural areas where the habitat appears good but there are increased predator densities (Young pers. obs.). Other important variables are fecundity and the effects of environmental stochasticity, such as drought and years with above average precipitation. Management practices intended to benefit FTHL have little effect on fecundity and precipitation. However, by reducing activities that result in mortality, directly or indirectly, management within reserves could increase the viability of FTHL populations. Thus, the population viability analyses suggest that actions that limit sources of mortality, versus other factors, will especially increase the chances that populations will persist into the future. Results also highlighted the need for accurate estimates of population variables, particularly age-specific clutch size and numbers of clutches produced per female annually; mortality rates, particularly for juvenile lizards; population density; and how population parameters vary over time and with precipitation or annual plant production. Better estimates of population variables would greatly enhance the value of population viability analyses in guiding the management of this species.

Threats

A variety of anthropogenic activities have altered or destroyed the landscape and native vegetation throughout much of the Sonoran Desert (Lovich and Bainbridge 1999). From the estimated historical range in the U.S. (Figure 2), the FTHL has lost approximately 49% of its original habitat (Hodges 1997). The Salton Basin had been subjected to frequent inundation from the Colorado River even prior to the accidental flooding from 1905 through 1907, and it is questionable whether this area can be considered historic habitat. If the 235,520 acres currently occupied by the Salton Sea are not considered historic habitat, the amount of habitat lost is approximately 43%. Rado (1981) estimated that about 315,000 acres of habitat in California had been lost to agricultural development and 83,000 additional acres for urban development (398,000 total acres lost). Hodges (1997) had much higher estimates, with 877,000 total acres lost to agricultural and urban development. She also noted that 24,000 acres in Arizona had been converted to agriculture and urban use. Additional unknown acreage has been degraded due to utility lines, geothermal development, sand and gravel mining, OHV use, waste disposal sites, military activities, Border Patrol (BP) activities, and roads. While initial evidence suggested that FTHL populations had declined in the Yuha Basin and northern East Mesa (Wright 1993; USFWS 1993), Wright (2002) recently found no significant trends in lizard encounter rates in Yuha Desert, East Mesa, or West Mesa from 1979-2001. Further evaluation of the status of these populations is necessary.

In Sonora, less than 20% of the habitat has been converted to agricultural, urban, or other uses. In Baja California Norte, considerable habitat loss has occurred in the Mexicali Valley where urban

and agricultural development extends from Mexicali to the Colorado River (Johnson and Spicer 1985).

Several aspects of FTHL ecology and behavior contribute to the species' sensitivity to habitat loss and degradation. Among these are the following: 1) the FTHL is distributed over a relatively small area (Figure 2); 2) relatively low clutch size may limit the ability of FTHL populations to recover from declines; 3) the large home range of the FTHL means that surface-disturbing activities may affect populations for relatively great distances from project sites; 4) FTHLs often freeze in response to danger, which makes them susceptible to mortality on roads and in other areas of activity; 5) FTHLs are found in valleys and flats where the majority of residential and agricultural development typically occurs; 6) FTHLs are susceptible to a variety of predators, many of which occur at elevated levels near agriculture or urban areas; and 7) FTHLs inhabit the most arid portions of the Sonoran Desert, in which drought is likely an important factor in population dynamics.

Agricultural Development

Conversion to agriculture eliminates FTHL habitat. Agricultural development has occurred primarily in the Imperial, Coachella, Mexicali, Borrego, and Colorado River valleys and on Yuma Mesa. Portions of the Colorado and Imperial valleys were converted entirely to agriculture many decades ago. Limited new agricultural development is continuing northward in the Imperial Valley along the edges of the Salton Sea and on Yuma Mesa. Similarly, in the Coachella Valley, development of new lands for agriculture is continuing, especially around Indio and southward adjacent to the Salton Sea. The rate of new development is relatively slow due to limitations on irrigation water.

Densities of some predators are elevated at or near agricultural lands. Relatively high densities of predators (e.g., round-tailed ground squirrel, common raven, greater roadrunner, American kestrel, burrowing owl, and loggerhead shrike) appear to result in elevated predation on FTHLs in adjacent undeveloped lands (Piest, Wong, Young, pers. obs.).

Urbanization

Urban development results in a direct loss of habitat and habitat degradation resulting from a variety of human activities. Southeastern California and southwestern Arizona are experiencing dramatic growth in human population. Most of the new urban development is occurring on agricultural lands in the Imperial, Coachella, and Colorado River valleys. However, some urban development is occurring in FTHL habitat in the Coachella Valley and Borrego Valley, California, and on the Yuma Mesa near Yuma and San Luis, Arizona. Growth is also occurring in San Luis, Sonora, including development of an 8,000-acre industrial park in FTHL habitat on the eastern end of the city. Direct impacts on FTHL habitat come from activities such as construction of commercial and residential buildings, landscaping for yards, parks, and golf courses, and road construction. Indirect effects of urbanization on adjacent FTHL habitat include route proliferation, increased OHV use, spread of non-native vegetation, and trash accumulation. Predators, such as common ravens, American kestrels, and domestic dogs and cats, also increase in urban areas, resulting in increased predation rates on FTHLs in adjacent wildlands (Bolster and Nicol 1989; Cameron Barrows, CNLM, pers. comm.).

Off-highway Vehicle Use

Over the past 20 years, there have been numerous bibliographies (e.g., Webb and Wilshire 1983) and literature reviews (e.g., Berry 1996) on the effects of OHV activity. In 1983, Webb and Wilshire (1983) published a comprehensive analysis on the impacts and management of OHVs in arid regions.

Legal OHV use falls into four basic kinds: 1) use of existing routes and trails for access and touring; 2) use of existing routes and trails by motorcycles, four-wheel drive vehicles, and all-terrain cycles as a recreational activity; 3) use of existing routes and trails for competitive vehicle events; and 4) cross-country travel in OHV "open areas."

Illegal OHV activity occurs in some areas but is limited by law enforcement, signing, and public information and education. The U.S. BP conducts patrols and rescues near the International Border that sometimes involve cross-country travel. BP OHV activity in FTHL habitat has greatly increased from 1997 to 2002 (Rorabaugh pers. comm.), but new BP practices, such as reliance on remote cameras, may reduce the amount of OHV traffic in the future (Wright 2002).

Currently, California BLM permits competitive events in the Superstition Mountains Open Area and the Plaster City Open Area on the western side of the FTHL's range. In addition, cross-country travel (or "free-play") is allowed in the BLM's Plaster City Open Area, the BLM's Superstition Hills Open Area, and the OWSVRA. Portions of these open areas support FTHL populations of various densities. However, FTHL encounter rates in BLM open areas have historically been only ¼ of those in the adjacent limited areas, suggesting an OHV related effect (Wright 2002).

The nature and extent of impacts of OHV use depends upon the kind of activity (Webb and Wilshire 1978; Adams *et al.* 1982). Most desert soils are susceptible to compaction from vehicles. Important factors determining the intensity of compaction are soil moisture, vehicle type, and amount of vehicle activity (Davidson and Fox 1974; Webb *et al.* 1978; Adams and Endo 1980). Compaction results in increased water and wind erosion and decreased water infiltration and retention. Important factors in erosion of desert soils are slope, soil particle size, and size of disturbed area (Adams and Endo 1980). Compaction of soils may negatively affect burrowing of FTHLs or the construction of ant nests. Changes in soil characteristics may affect the ability of the soil to support vegetation, resulting in decreased density, diversity, and biomass of plant cover (Davidson and Fox 1974; Webb *et al.* 1978).

OHVs may impact vegetation by physically damaging roots, stems, or whole plants (Hall 1980). The resulting decrease in biomass and/or change in species diversity may result in a reduced or degraded food base for ant prey species. In addition, decreases in plant cover will decrease protection from predators, shelter from solar heating and wind, and may affect sand accumulation and retention.

The current state of knowledge of the impacts of OHV use on the FTHL is both incomplete and inconclusive. The results of work performed by Utah State University (Setser 2001) at the OWSVRA suggest that FTHLs are found less often in areas disturbed by OHVs than in areas that were randomly selected. However, FTHLs were found within 10 m of an impact area at a frequency similar to that of random locations, suggesting that vehicle impacts may be localized. Wright (2002) and Rorabaugh *et al.* (2002) found FTHLs persisting in areas of MAs that had the greatest levels of OHV disturbance observed in California and Arizona. Wright (2002) found no consistent

relationship between vehicle impacts and flat-tailed horned lizard detection rates, but Wright and Grant (2002) noted that plots with less than 9% vehicle track coverage (n = 6) had 3.5 times more lizards than plots with greater than 9% track coverage (n= 6, p = 0.05). Substrate differences between plots was a confounding variable. These results must be interpreted cautiously since no well-controlled study has been conducted to determine effects of OHVs on FTHLs. The OWSVRA continues to support research addressing the impacts of OHV use on the FTHL.

In addition to the indirect effects noted above, FTHLs could be killed directly by being run over, either above ground or in burrows. FTHL winter burrows are shallow (average depth of 5.6 cm, range 2.6-10.0, n=6; Muth and Fisher 1992); thus, vehicles may crush burrows and lizards in burrows. Bury *et al.* (1977) found reduced biomass, density, and diversity of reptiles in heavily used areas of OHV open areas.

It has been shown that prolonged noise can adversely affect some lizards (e.g., desert iguana, Mojave fringe-toed lizard) (Bondello 1976; Brattstrom and Bondello 1983). However, it is not known whether or not vehicle noise at levels and durations anticipated in the desert negatively impact FTHLs. Effects are more likely where prolonged, loud noise occurs. A bibliography of literature on the effects of noise on animals can by found in Brattstrom (1978).

Off-road activity has increased dramatically over the last decade in the Yuma Desert, Yuha Desert, and West Mesa MAs (Wright 1993; Rorabaugh, pers. obs.). In the Yuha and southern half of the West Mesa MAs in 2001, 10.5 and 6%, respectively, of the surface area was covered by vehicle tracks (Wright 2002), which was a significant increase over 1994. Wright could not determine how much of this increase came from BP, smugglers, or recreationalists. Routes in the southern part of the East Mesa MA decreased by 45% from 1994 – 2001. In the Yuma Desert MA, off-road vehicle tracks covered 2.9% of the ground surface in the BMGR portion, and 3.4% of the surface in the 5-Mile Zone portion of the MA (Rorabaugh *et al*. 2002). The authors suspected that much of the off-road traffic was attributable to BP.

Highways, Canals, Railroads

Mobile species are commonly killed by vehicle traffic along well-traveled roads. Road mortality can significantly decrease amphibian and reptile densities along roads (Nicholson 1978a, b; Rosen and Lowe 1994; Carr and Fahrig 2001). Grant *et al*. (2001) found 87% fewer FTHLs within 0.45 mile of Highway 98 in Imperial County, California, as compared to areas farther from the road. Young and Young (2000) suggested FTHL populations would be affected within 0.3 mile of a road, with severe impacts within 0.15 mile. Such mortality could depress local populations and function as a partial barrier to movement. FTHLs are less likely to be run over on railroads, but the tracks may create a significant barrier to movements. Numerous roads and highways bisect remaining FTHL habitat. Within the Coachella Valley, I-10, a busy freeway, separates remaining populations, and smaller well-traveled roads fragment remaining habitat to the north and south of I-10. Further south in California, State Routes 86, 78, and 98, and Interstate 8 divide habitat areas. It is possible that some FTHL movement occurs across these roads, but they likely function as effective barriers to most FTHL movement. Numerous smaller roads exist throughout California that are likely to depress local populations but may allow more movement between populations than these major highways.

The Arizona Department of Transportation is developing a proposal to construct the Area Service Highway linking the Araby Road Exit on Interstate 8 and the planned commercial port of entry

just east of San Luis, Arizona. The proposed route would pass through approximately 10 miles of previously undisturbed FTHL habitat and would upgrade and pave approximately 5 miles of an existing dirt road. The new commercial port of entry may facilitate urban and industrial development, which could cause further loss of habitat on both sides of the international border.

Canals probably function as nearly absolute barriers, with FTHLs able to cross only at bridges and siphons. Some may drown in large canals as well as small agricultural drains, but the significance is unknown. Barriers to movement can create small, local populations which are susceptible to stochastic events and extinction, and which cannot be recolonized from adjacent populations (Wilcox and Murphy 1985). For example, the Andrade Mesa, a small strip of FTHL habitat in California north of croplands in Mexico and south of the All-American Canal, is effectively isolated. Highways, canals, and railroads may also facilitate urban and agricultural development, which results in further loss, degradation, and fragmentation of habitat. Within California, the Coachella Canal and the All-American Canal bisect FTHL habitat and separate populations. This likely isolates the population to the east of the Coachella Canal (including animals found in the Algodones Dunes and to the east of the dunes) from the East Mesa population.

The BOR and cooperating water districts have proposed construction of a new, concrete-lined All-American Canal adjacent to the existing unlined canal, from 1 mile west of Pilot Knob to Drop 3 of the Canal in southeastern Imperial County, California (BOR and Imperial Irrigation District 1990). Construction would destroy a linear strip of desert scrub and dune habitat approximately 400 to 600 feet in width and 23 miles in length. Approximately 725 acres of FTHL habitat would be lost (Bransfield and Rorabaugh 1993). The project currently is postponed, but is likely to occur as water needs escalate in southern California.

Military Activities

The FTHL inhabits two military installations, Naval Air Facility (NAF) near El Centro, and the western BMGR administered by MCAS-Yuma. The FTHL also occurs at the former Salton Sea Test Base. MCAS-Yuma manages 114,800 acres within the Yuma Desert MA, and NAF-El Centro manages 29,800 acres within the West Mesa MA and 8,500 acres in the East Mesa MA.

At NAF-El Centro, Range 2510 intersects the West Mesa MA and Range 2512 intersects the East Mesa MA. The training ranges are used for aircraft familiarization, air-to-air refueling, tactical air control, inert (non-exploding) bombing, inert rocket/small arms firing, air combat maneuvering, air intercept, survey flights, search and rescue flights, and air defense exercises (NAF-El Centro 2001). Three target areas within FTHL habitat are used for high, intermediate, and low altitude inert bombing and inert rocket-firing exercises, and for special weapons and conventional delivery of inert ordnance. Each target has an impact radius of up to 1,500 feet. Other activities include target maintenance, clean up of target sites, road maintenance, mobile target activity, and target and run-in-line grading. Most activity is confined to previously disturbed areas such as existing roadways and designated staging areas, so very little off-road activity is required. However, unauthorized public OHV recreation occurs in these areas.

At the BMGR, the Yuma Desert MA intersects Range 2301W which includes two targets in FTHL habitat. The targets have an impact radius of up to 1,500 feet, and are used for inert air-to-ground rockets, bombs, and strafing. Other activities within FTHL habitat include the use of precision air-to-ground lasers, explosive ordnance disposal, rifle and pistol training, and tactical landing at Auxiliary Airfield 2. Other activities include target maintenance, clean up of target sites, and road

maintenance. Most activity is confined to existing roadways and designated staging areas, so very little off-road activity occurs. The BMGR and Yuma Desert MA are immediately adjacent to the Mexican border, so undocumented alien traffic and U.S. BP off-road vehicle activity are common in the area. The BMGR portion of the Yuma Desert MA is closed to the public and patrolled by MCAS.

Most military activities result in small amounts of direct habitat disturbance, or occur in previously disturbed habitat, so effects on FTHLs and their habitat are likely to be small except where activities are concentrated. Some incendiary devices could start wildfires (see discussion of Fire as a threat on p. 19), although the Integrated Natural Resource Management Plans include measures for fire suppression. Explosion of ordnance and aircraft noise could potentially cause hearing loss in lizards at or near the noise sources (Brattstrom and Bondello 1983).

Utilities

Harm and harassment of FTHLs as well as direct habitat disturbance may result from installation and maintenance of utilities such as transmission lines, pipelines, and fiber optic cable lines. Habitat disturbance from transmission lines results primarily from installation of towers, construction and use of access routes to the tower sites, use of the tower site, use of line-pulling sites, and maintenance activities. Total direct disturbance is relatively small, usually less than 8 acres per mile. Vasek *et al*. (1975a) found in the Mojave Desert that the overall, long-term effects are a permanently devegetated maintenance road, enhanced vegetation along the road edge and between tower sites, and reduced vegetation cover under the towers, which recovered significantly but not completely in about 33 years. If crushing, rather than blading, is required, time to recovery of spur routes, tower sites, and pulling sites can be reduced. Although new access routes are usually required, sometimes transmission lines are placed along existing maintenance roads. An indirect but potentially large impact is that loggerhead shrikes and other avian predators can use the transmission lines and towers to more effectively prey upon FTHLs (Young and Young 2002).

Direct habitat disturbance from pipelines results from trenching, stockpiling of fill, refilling the trench, and moving vehicles along the corridor during construction and inspections. Total disturbance is also relatively small but greater than transmission lines (i.e., usually less than 16 acres per mile). Natural habitat restoration in the construction zone requires many decades and perhaps centuries (Vasek *et al*. 1975b).

Direct habitat disturbance from burying fiber-optic cable results primarily from the crushing of vegetation where the tracked vehicle lays the cable. The disturbed area is usually narrow (< 4 m), resulting in a small disturbance overall (usually less than 1.5 acres per mile).

Pipelines, transmission lines, or fiber-optic cables are not likely to function as barriers to movements. However, roads constructed to build or maintain these utilities may cause a proliferation of new access roads into previously undisturbed areas, resulting in off-site habitat disturbance.

Predation

Round-tailed ground squirrels (*Spermophilus tereticaudus*) appear to be the chief predator of FTHLs. They were responsible for 50% of known mortalities of transmittered FTHL on West Mesa MA in 1990-1992 (Muth and Fisher 1992), and they killed 30% of all transmittered FTHLs in 1996

and 10% of transmittered FTHLs in 1998 in the Yuma Desert MA (Young and Young 2000). However, at OWSVRA ground squirrels were uncommon and did not prey upon transmittered FTHLs (Setser 2001). Loggerhead shrikes are also important predators of FTHL (Duncan *et al.* 1994; Muth and Fisher 1992; Young and Young 2000). Other documented predators include American kestrel (*Falco sparverius*) (Duncan *et al.* 1994; Cameron Barrows, CNLM, pers. comm.), common raven (*Corvus corax*) (Duncan *et al.* 1994), burrowing owl (*Athene cunicularia*) (Duncan *et al.* 1994), sidewinder (*Crotalus cerastes*) (Funk 1965; Muth and Fisher 1992), coachwhip (*Masticophis flagellum*) (Young and Young 2000), kit fox (*Vulpes macrotis*) (Duncan *et al.* 1994; Muth and Fisher 1992; Young and Young 2000), and leopard lizard (*Gambelia wislizenii*) (Carlson and Mayhew 1988; Young 1999). Other likely predators of FTHLs include the greater roadrunner (*Geococcyx californianus*), thrashers (*Toxostoma* spp.), patch-nosed snakes (*Salvadora hexalepis*), glossy snakes (*Arizona elegans*) (Muth and Fisher 1992), and large scorpions (*Hadrurus arizonensis*) (Turner and Rorabaugh 1998). Muth and Fisher also suspected the leaf-nosed snake (*Phyllorhyncus decurtatus*) was a possible predator, but recent evidence (S. Gardner 2002) suggests this is unlikely. Predator densities are often elevated near human development (Bryant 1911). For example, data from the Breeding Bird Survey show that populations of common raven have increased 4.7-fold in the Colorado Desert between 1969 and 1988 (BLM *et al.* 1989). Cameron Barrows (CNLM, pers. comm.) documented high predation rates from a kestrel pair nesting in a palm tree just outside the Coachella Valley Preserve. He also noted severely depressed FTHL populations within 0.1 mile of a road in the Coachella Valley, a result of predation by kestrels and shrikes that nested in nearby housing areas and golf courses and hunted from power poles along the roads. Round-tailed ground squirrels and roadrunners occur at elevated densities near agricultural areas and may explain absence of FTHLs in some areas of apparently suitable habitat adjacent to agriculture (Wong & Young, pers. obs.). Elevated predation may contribute to a cumulative set of adverse effects that result in population declines in some areas.

Energy and Mineral Extraction

Mining and Mineral Material Extraction

Mining and mineral extraction activities cause habitat loss and degradation because of long-term loss of vegetation cover and removal of topsoil. Associated activities, such as truck and light vehicle traffic, can result in direct mortality within the project area as well as outside of the project site along access roads. Even though most mineral material sites (e.g., sand and gravel) are small, their cumulative effect can be significant. The acreage of mining and mineral sites within FTHL MAs has not been mapped and quantified.

Geothermal Power Development

Geothermal power development is occurring in the Imperial and Mexicali valleys, particularly in agricultural lands, but also in adjacent desert lands. Much geothermal development has occurred in FTHL habitat in the southwestern portion of East Mesa. Power plant construction, wells, pipelines, transmission lines, and service roads cause habitat loss and degradation. Currently, geothermal energy companies believe that the geothermal resource is exploited at or near capacity (Rob Waiwood, Geologist, BLM California Desert District, pers. comm.). No additional power plants are proposed for East Mesa. Some additional disturbance will occur from replacement wells and associated facilities (e.g., pipelines).

Oil and Gas Development

Extensive leasing by the federal government of oil and gas rights occurred in the early 1980's in the Salton Sea Trough. Some leasing also occurred in the Yuma Desert south of Yuma. These leases were highly speculative. Only one test well was drilled in California, and two test wells were drilled in Arizona. None of these wells were profitable, and no oil or gas resources have been identified. At present there are no active federal leases for oil and gas within the range of the FTHL in the U.S.

Potentially, portions of public land within the range of the FTHL could be offered for lease in the future. Leasing, which is discretionary, would not take place unless interest had been expressed by the oil and gas industry. Any leasing would be required to adhere to regulatory standards (43 CFR 3100 et seq.). Oil and gas leases may be issued with standard stipulations as well as additional stipulations for sensitive areas, including stipulations requiring no surface occupancy.

The development of an oil and gas field would result in loss or degradation of habitat from well pads, pipelines, and service roads. Some direct mortality could occur on roads used by trucks and other vehicles. Under current regulations the amount and location of disturbance on federal lands would be subject to strong controls.

Wind Turbines

Wind turbines cover about 317 acres of FTHL habitat in the northwestern portion of the Coachella Valley. Some habitat is lost where turbine platforms are built, and there may be some road mortality on the dirt maintenance roads. However, the turbines have mainly been built on gravel floodplains and foothill slopes, where FTHLs are unlikely to occur. Furthermore, there may be an indirect positive effect in that the presence of wind turbines keeps the habitat from being converted to urban use, which is the primary cause of habitat loss in the Coachella Valley. The turbines may also reduce densities of avian predators.

Landfills

In recent years there have been increasing attempts to place large, regional landfills serving distant urban centers in remote areas, such as the Colorado Desert. The proposals range from 2,000 to 20,000 acres in size. Large landfills in FTHL habitat would result in a permanent loss of habitat. Additional degradation of habitat as well as direct mortality and population fragmentation would occur from trash transportation, such as railroads and roads, and ancillary facilities. Although strongly stipulated to limit the effect, landfills may increase populations of predators (e.g., ravens, roadrunners) that potentially could prey on FTHLs many miles from the landfill.

In the past, the federal government issued leases to cities and counties for landfills serving local areas. Currently, federal agencies are disposing of, primarily through exchange or sale, lands proposed for landfills. Local agencies may still develop new sites on private lands in wildland areas. Even though relatively small in size (10-200 acres), these landfills would result in negative effects on FTHLs similar to large, regional landfills.

BOR sold 640 acres of land south of Yuma to the city of Yuma for a regional landfill prior to the Conservation Agreement. The land is located just east of the Arizona state prison along County 23rd Street. It is currently undeveloped and occupied by FTHLs. This landfill will replace the existing Yuma County landfill located east of Somerton, when that landfill reaches capacity.

Exotic Plants

Many species of introduced, non-native plants occur in FTHL habitat. Most are Mediterranean or Asian annual species that germinate in the winter or spring months. Split grass (*Schismus barbatus*) is common throughout the range of the FTHL and locally abundant. Sahara mustard (*Brassica tournefortii*) and Russian thistle (*Salsola tragus*) are locally abundant. Sahara mustard appears to be spreading rapidly in some areas. Many other non-native annual species may be present, especially species in the families Gramineae (grasses), Chenopodiaceae (goosefoots), Cruciferae (mustards), and Compositae (sunflowers), particularly near agricultural areas and near streams or wetlands. Density, diversity, and productivity of both native and non-native annual plants vary greatly from year to year. In years with abundant winter and spring rainfall, densities and diversity of annual plants are often relatively high (Tevis 1958; Inouye 1991; Rorabaugh 1994).

The effects of non-native annual plants on the FTHL are unknown. However, their abundance in FTHL habitat is of concern for several reasons. In portions of East Mesa, the Coachella Valley, and habitat in Sonora, densities of Russian thistle and/or Sahara mustard are very great in some years, with stem or culm densities perhaps great enough to impede movement by FTHLs, which are relatively wide-bodied and active. As discussed in the following section on fire, high productivity of non-native annuals can fuel fires that destroy native perennial shrubs and facilitate changes in plant composition.

Where non-native annuals have significantly changed plant communities, the types of food available to harvester ants have also been altered. Relationships among species of harvester ants and between ant populations and environmental variables are complex (Ryti and Case 1988; Mackay 1991). Changes in annual plant communities may trigger changes in ant communities that could, in turn, affect predators of ants, including FTHLs.

In addition to non-native annual plants, saltcedar (*Tamarix ramosissima*), a non-native perennial shrub or tree, has invaded areas of shallow groundwater in FTHL habitat on the west side of West Mesa, in the Yuha Basin (Wright 1993), and along portions of the All-American and Coachella Canals. FTHLs have been recorded in saltcedar communities (Kim Nicol and Betsy Bolster, CDFG, pers. comm.), but dense stands of saltcedar are likely unsuitable for them.

Fire

In the summer of 1992, a dense, dried stand of non-native annual plants fueled a fire in northern East Mesa that burned approximately 3,600 acres. Although the effects of the fire have not been quantified, large numbers of perennial shrubs, particularly creosote, were killed. Restoration of perennial cover after the fire has been very slow. Dried, non-native plants in the Coachella Valley have also fueled several small fires of less than ten acres. Habitat in portions of the Coachella Valley, on East Mesa, and in Sonora support dense stands of non-native annuals and, as a result, is particularly susceptible to fire. Presumed ignition sources of fires within habitats occupied by FTHLs include: lightning strikes, campfires, highway and railroad sources, catalytic converters on OHVs, military activities (particularly use of flares and bombing), and other activities. Fires are more frequent near towns and roads (Tracy 1994) and are likely to occur after annual plants cure in the spring and before late summer or winter rains reduce the fire hazard.

The effects of fire on FTHL habitat have not been studied. However, many species of perennial shrubs in desert scrub habitats are generally poorly adapted to fire (Brown and Minnich 1986; Minnich 1994). Fire in desert scrub communities causes vegetational conversion to communities that are more fire tolerant (Minnich 1994). Recovery of pre-fire cover and biomass of desert shrubs is achieved only after several decades (Minnich 1994). Creosote and white bursage, which are often dominant perennial shrubs in FTHL habitat, typically experience high mortality during fires. Big galleta grass, also an important perennial in some areas, resprouts vigorously after fire (Minnich 1994). Although fire suppression activities are needed to control the size of fires, off-highway access during fires and creation of fire lines can result in habitat damage (Duck *et al.* 1994).

If fire occurs when FTHLs are on or near the surface, individuals could be killed directly by the fire. The effects of vegetation community conversion on FTHLs are unknown, but decreased shrub cover could make individuals more susceptible to predation and environmental extremes. Changes in plant community composition could also facilitate changes in substrates and ant populations that could adversely affect FTHLs. Additional study is needed to quantify the effects of fire on this species and its habitat.

Pesticide Use

Agricultural fields in the range of the FTHL are sprayed aerially with insecticides to control various insect pests. These pesticides may drift onto adjacent wildlands and kill ants, the primary prey of FTHLs (BLM 1990). Pesticide drift is less likely to be concentrated sufficiently to kill FTHLs directly, but dosages may become lethal if accumulated in the tissues by consuming contaminated prey. Sublethal effects on lizards are poorly studied and pesticide tolerances of FTHLs are unknown (Johnson 1989). Drift of herbicides from croplands may also injure or kill plants in adjacent FTHL habitat.

Since 1943, the California Department of Food and Agriculture has conducted a control program for the exotic sugar beet leafhopper (*Circulifer tenellus*), a carrier of curly top virus, which damages crops. The program has entailed aerial application of insecticides (DDT from 1956-1965 and malathion since 1965) in areas known to harbor the insect. In the past this has included portions of East Mesa, West Mesa, and Yuha Basin in California (Calif. Dept. of Food and Agric. 1991). Historically, treatments in the Imperial Valley have occurred in about one out of every three years with aerial treatment acreage varying between 3,000 and 27,000 acres. The last two aerial treatments in Imperial County were in 1992 and 1998, with treatment acreages of 7,143 and 5,900 respectively (Calif. Dept. of Food and Agric. 2002).

Effects of malathion on the FTHL have not been studied; however, studies on other lizards have shown no direct effects at applications many times higher than planned here (Peterle and Giles 1964; Giles 1970; Hall and Clark 1982). Harvester ants, which are the primary prey of FTHLs, are killed by the insecticide treatments (Bolster and Nicol 1989). Proposed treatment protocols call for application during night or early morning hours in the winter or spring. Since most ants in a colony are underground during these cool periods, few ants should be killed directly (Calif. Dept. of Food and Agriculture 1995). Monitoring efforts have shown that, although foraging individuals may be killed in significant numbers, ant colonies recover quickly following malathion spraying (Peterson 1991; Calif. Dept. of Food and Agric. 2002). However, no rigorous studies have investigated the effects of malathion spraying on harvester ant populations within the range of the

FTHL, therefore the conclusions of these monitoring efforts are as yet unsupported. Spraying, if necessary, typically would occur at or near the time of emergence of hibernating FTHLs. This would likely affect populations in sprayed areas, because food resources (ants) would be temporarily reduced. Therefore, malathion spraying is considered inconsistent with FTHL conservation in FTHL MAs.

Despite mitigation measures, the overall effects of the program are uncertain. Effects of applying broad-spectrum insecticide over many years to desert scrub communities are potentially many and complex. For instance, changes in invertebrate communities may include changes in pollinator and herbivore populations, which may in turn alter plant communities. Changes in plant communities could precipitate further changes in invertebrate communities and create altered conditions for vertebrates, as well. The effects of this program need further study. The USFWS has issued a biological/conference opinion, and a recent update, on the beet leafhopper control program (USFWS 1996b; USFWS 2001). The terms and conditions stipulate that no treatments may occur in FTHL MAs, and that aerial treatments in habitats elsewhere that support high densities of FTHLs should be restricted to the fall and winter months to the extent possible. The most recent decision of the BLM California State Director (March 11, 2002) in authorizing a beet leafhopper malathion control program on public lands in California includes the following terms and conditions:

"9. No treatments shall be applied in designated flat-tailed horned lizard management areas, as set forth in the Flat-tailed Horned Lizard Rangewide Management Strategy (Twedt 2001). Treatments within other flat-tailed horned lizard habitats shall be limited to not more than one application in a given area per year.

10. Harvester ant monitoring shall be conducted in association with any treatments that occur in flat-tailed horned lizard habitat in the Imperial Valley."

Land Disposal

Lands that are removed from federal or state ownership are available for agricultural development, urban development, landfills, or other surface disturbing activities consistent with local zoning regulations. These activities result in varying degrees of habitat loss and adverse effects to FTHL populations.

The Arizona State Land Department is disposing of land occupied by FTHLs in two areas: 1) near Fortuna Road east of Yuma and south of Interstate 8 and 2) near the town of San Luis. The parcels of state lands that are currently being sold are immediately adjacent to residential and commercial development and have reached what the State Land Department feels is their peak value. It is expected that these lands will be developed as housing or commercial property soon after their sale and thus will no longer be useable as habitat for FTHLs. The State Land Department is currently denying land sale applications for other state land parcels in FTHL habitat because these lands have not yet reached their highest potential value. Recently, however, they have leased significant parcels of habitat for agricultural development.

Cattle Grazing

Historically, portions of FTHL habitat in the U.S. were grazed (e.g. East Mesa) as ephemeral pasturelands; however, we are not aware of any grazing currently occurring in the U.S. range of the species. Cattle grazing occurs at least seasonally in some portions of Sonora where FTHLs are

found. In dry periods, cattle congregate around water sources and corrals, such as at Pozo Nuevo, Sonora. During wet winters and springs when annual plants are abundant, cattle may stray far from water and ranchers often truck in additional stock to take advantage of abundant forage. Areas in the immediate vicinity of water are often heavily trampled and denuded of vegetation. The effects of livestock grazing on the FTHL are unknown; however, grazing can reduce populations of other lizards (Jones 1981; Bock *et al.* 1990; Mitchell 1999). Heavy grazing is widely recognized as having serious deleterious effects on desert soils, vegetation communities, and fauna; however, effects of light to moderate grazing are not as well documented (see review in Lovich and Bainbridge 1999).

Other Activities

Various specialized projects and facilities have been constructed or proposed for desert areas that provide habitat for the FTHL. As habitat is lost to these projects, populations of FTHLs are reduced accordingly. Examples of such projects are the Arizona state prison in the Yuma Desert, which occupies about 640 acres of former FTHL habitat, and the nearby A-22 site that BOR had developed prior to the Conservation Agreement for disposal of salt sludge produced by the Yuma Desalting Plant. Development at the A-22 site currently occupies about 160 acres but would be expanded to as large as 960 acres if or when the desalting plant began full-scale operation.

Listing History

In California, the FTHL was designated a sensitive species by the BLM in 1980 (BLM 1980). The purpose of the designation was to provide increased management attention to prevent population declines and habitat loss or degradation that might result in federal or state listing as endangered or threatened. The designation raises the level of concern for FTHLs in the environmental review process and in land use planning. No specific habitat or population protection measure or review process is required or prohibited by the sensitive species designation. By present BLM policy, species designated sensitive are, at a minimum, afforded the protection provided candidate species (BLM 1988). This includes direction to 1) determine distribution, abundance, and population status, 2) develop a habitat management program, and 3) coordinate with the USFWS (BLM 1988).

On January 25, 1988, the California Department of Fish and Game (CDFG) Commission received a petition requesting listing of the FTHL as an endangered species. On May 13, 1988, the Commission accepted the petition and designated the FTHL a candidate species (Carlson and Mayhew 1988). The CDFG reviewed the petition and other information and recommended in its review (Bolster and Nicol 1989) that the species be listed as threatened. On June 22, 1989, the Commission voted against the proposed listing.

The Arizona Game and Fish Department (AGFD) currently includes the FTHL on its draft list of wildlife of special concern (AGFD in prep). This designation affords no legal protection to the species, but is used in planning to encourage habitat conservation and management consideration. Collecting or killing FTHLs is prohibited in both Arizona and California, except by special permit.

The USFWS included the FTHL as a Category 2 candidate for listing as a threatened or endangered species in its original "Review of Vertebrate Wildlife" published in the *Federal Register*, December 10, 1982 (USFWS 1982). Category 2 candidate species were those for which data in the USFWS possession indicate that listing may be appropriate, but additional information is needed to

support a proposed rule. In a 1985 revision of the candidate list, the species was retained as a Category 2 candidate (USFWS 1985). Due to new data (especially Rorabaugh *et al*. 1987, Carlson and Mayhew 1988, and Olech undated), the USFWS elevated the FTHL to a Category 1 candidate in its revised list issued on January 6, 1989 (USFWS 1989). Category 1 candidate species were those for which the USFWS had sufficient information to support a proposal to list them as threatened or endangered.

On November 29, 1993, the USFWS published a proposed rule to list the FTHL as a threatened species (USFWS 1993). The USFWS cited "documented and anticipated population declines associated with widespread habitat loss, fragmentation, and degradation due to human activities such as agricultural developments, urban expansion, OHV use, energy developments, and military activities" as the primary bases for the proposed listing. The USFWS could not determine critical habitat at that time. A public meeting was held in El Centro on March 22, 1994, to gather public comment. The passage of Public Law No. 104–6, 109 Stat. 73 in April 1995 delayed consideration of listing the FTHL until an executive waiver, signed by President Clinton on April 26, 1996, allowed the Secretary of the Interior to again list species for protection under the Endangered Species Act.

In response to a lawsuit brought by the Defenders of Wildlife and others, the Secretary of the Interior was ordered by the district court in Arizona on May 16, 1997 to, within 60 days, issue a final decision on the listing of the FTHL. On July 15, 1997 the Secretary of the Interior issued a notice to withdraw the proposal to list the FTHL based on three primary factors: 1) population trend data did not conclusively demonstrate significant population declines; 2) some of the threats to the habitats occupied by FTHLs had become less serious since the proposed rule was issued; and 3) the 1997 Conservation Agreement and RMS would ensure a further decrease in threats to the FTHL and its habitat (USFWS 1997). The Defenders of Wildlife and others again filed suit against the Secretary of the Interior in district court. On June 16, 1999, the district court for the Southern District of California issued a summary judgment upholding the Secretary of the Interior's decision not to list the FTHL.

The Defenders of Wildlife and others appealed the case to the Ninth Circuit Court of Appeals, which on July 31, 2001 reversed the district court's ruling and asserted that the Secretary of Interior's decision to withdraw the FTHL from consideration for listing was "arbitrary and capricious". The primary reasoning for this decision was that the Secretary of the Interior did not adequately address the meaning of the phrase, "in danger of extinction throughout … a significant portion of its range" and how an adequate interpretation of this phrase applies to the status of the FTHL. Furthermore, the court expressed concern about the incomplete implementation of the 1997 Conservation Agreement. On October 24, 2001, the district court ordered the Secretary of the Interior to reinstate the 1993 proposed rule to list the FTHL. The proposed rule was reinstated December 26, 2001 (USFWS 2001).

On January 3, 2003, the USFWS withdrew the proposed rule to list the FTHL as a threatened species (USFWS 2003). They determined that listing was not warranted because threats to the species as identified in the proposed rule were not as significant as earlier believed, and current available data did not indicate that the threats to the species and its habitat are likely to endanger the species in the foreseeable future throughout all or a significant portion of its range.

The Mexican Government has designated the FTHL a threatened species. As such, the species is protected from collection, sale, and commerce, and its habitat is afforded special protection

(Secretaría de Medio Ambiente y Recursos Naturales 2002). An international consortium selected the FTHL and portions of its habitat as conservation priorities in an ecosystem-wide analysis (Marshall *et al.* 2000).

MANAGEMENT PROGRAM

Overall Goal

MAINTAIN SELF-SUSTAINING POPULATIONS OF FLAT-TAILED HORNED LIZARDS IN PERPETUITY.

Management Objectives

- Continue to secure and/or manage sufficient habitat to maintain self-sustaining FTHL populations in each of the five designated MAs (Yuma Desert, East Mesa, West Mesa, Yuha Desert, and Borrego Badlands MAs) and in areas designated by the CVMSHCP.
- Maintain a "long-term stable" or increasing population of FTHLs in all MAs. A population that is stable over the long term exhibits no downward population trend after the effects of natural demographic and environmental stochasticity are removed.
- Continue to support research that promotes conservation of the species at OWSVRA and elsewhere throughout the range of the species.
- Within and outside of MAs, limit the loss of habitat and effects on FTHL populations through the application of effective mitigation and compensation.
- Encourage and assist Mexico in the development and implementation of a FTHL conservation program.

Overview and Purpose

In 1994, the USFWS, BLM, BOR, DOD, and several other agencies signed a MOU "...on Implementation of the Endangered Species Act" that established a general framework for cooperation and participation among cooperators in the conservation of species tending toward federal listing as threatened or endangered under the Endangered Species Act. The MOU identified the development of conservation agreements as a valuable process for achieving conservation of species through voluntary cooperation. A conservation agreement is a formal, written document agreed to by the USFWS and other cooperators that identifies specific actions and responsibilities for which each party agrees to be accountable. The objective of a conservation agreement is to reduce threats to a candidate species or its habitat, possibly lowering the listing priority or eliminating the need to list the species.

This strategy formed the basis of a conservation agreement among the cooperators for management of FTHLs (Foreman 1997). The conservation agreement that was signed is included as Appendix 1. Although the USFWS determined that the conservation agreement was effective and that listing the FTHL was unnecessary, it retains the ability to reconsider the effectiveness of the agreement. Lack of compliance among the cooperators, a change of circumstances, or other reasons may alter the expected result of this strategy. If threats to the FTHL or its habitat are not reduced, the USFWS may proceed with another proposed or an emergency listing.

The purpose of this strategy is to provide a framework for securing and managing sufficient habitat to maintain several self-sustaining populations of the FTHL throughout the species' range in the U.S. (see Habitat Management, p. 49). A major step towards that objective was the establishment of five MAs encompassing large blocks of habitat where surface disturbing and

mortality causing activities are minimized. Prior to the RMS, management of federal lands within FTHL habitat was guided by several management plans, as discussed in Appendix 2. These plans cover federal lands both within and outside the MAs. When the MAs were established, this document became the standard for management and conservation of FTHL habitat. Signatory agencies have incorporated measures in the RMS into their land management plans to comply with the NEPA and state counterparts.

Outside of these MAs, FTHL habitat receives a degree of protection through mitigation and compensation and through the previously established habitat management plans that affect public lands outside of MAs (Appendix 2). Specifically, signatories to the conservation agreement ensure that adverse effects of projects they authorize outside of MAs are mitigated and that residual effects are compensated in accordance with a standard formula (see Mitigation and Compensation). The funds obtained through compensation are used to consolidate land ownership within the MAs or to enhance habitat.

As part of its adaptive management approach, programs for monitoring FTHL population, distribution, and habitat disturbance have been established (see Monitoring Program, p. 66 and Appendix 4 and Appendix 5). If population or distribution declines occur, the ICC shall investigate potential causes. If causes are anthropogenic in nature, the ICC shall make recommendations to the MOG for reversing the trend.

This document is the first revision of the 1997 RMS (Foreman 1997). Because the Implementation Schedule will expire in 2008, it is expected that the schedule will be revised at that time. Concurrently, the need for a revision of the entire document will be evaluated.

Planning Actions

The following Planning Actions have been developed as recommendations to signatory agencies to ensure that the goal of maintaining a "long-term stable" population within each MA is achieved. The original Planning Actions from the 1997 RMS are repeated here, though some of these actions have been completed. Actions that have been identified since 1997 have been added. It is understood that implementation of these actions is subject to availability of funds and compliance with all applicable regulations. It is anticipated that specific actions may be modified based on information obtained from future monitoring, research, and evaluations of the effectiveness of this strategy. Annual evaluations and proposed modifications of this strategy shall be coordinated through the FTHL ICC. The MOG will meet as necessary to review recommendations of the ICC and may make corresponding modifications to Planning Actions in the RMS.

1. **Delineate and designate five FTHL MAs and one FTHL RA. See Table 3 for a summary of land ownership within each MA. Boundary descriptions and geographic information system (GIS) maps are on file with land management agencies.**

   1.1. Designate the Yuma Desert FTHL MA as shown in Figure 4. If the proposed Area Service Highway is constructed along a portion of the boundary of the MA, the east and south side of the ROW will be the new western and northern boundary of the MA, as appropriate.

   1.2. Designate and complete NEPA process for the East Mesa FTHL MA as shown in Figure 5.

1.3. Designate and complete NEPA process for the West Mesa FTHL MA as shown in Figure 6.

1.4. Designate and complete NEPA process for the Yuha Desert FTHL MA as shown in Figure 7.

1.5. Designate and complete California Environmental Quality Act process for the Borrego Badlands FTHL MA as shown in Figure 8.

1.6. Designate the OWSVRA as the Ocotillo Wells FTHL RA as shown in Figure 9.

1.7. Continue to manage areas in the Coachella Valley that are capable of sustaining viable populations of FTHL by working with other agencies and organizations in finalizing a CVMSHCP (see Figure 10).

2. Define and implement management actions necessary to minimize loss or degradation of habitat.

2.1. Mitigate and compensate, as needed (Appendix 6), project impacts on FTHLs and their habitat both within and outside of MAs and the RA through humane and cost-effective measures.

2.1.1 Apply mitigation measures as appropriate, based on the nature of the anticipated impacts (see Mitigation section).

2.1.2 Require compensation for residual impacts remaining after application of other on-site mitigation measures (see Compensation section).

2.2. Limit land use authorizations that would cause surface disturbance within the MAs.

2.2.1 Land use applications will continue to be reviewed on a case-by-case basis for impacts on FTHLs and their habitat. Every attempt shall be made to locate projects outside of MAs. New ROWs may be permitted only along the boundaries of MAs and only if impacts can be mitigated to avoid long-term effects on FTHLs in the MA. Where discretionary, other new authorizations may be permitted if the habitat disturbance does not pose a significant barrier to lizard movements. Disturbance shall be limited to 10 acres or less per authorization, if possible. If individual disturbances over 10 acres are necessary, the ICC and the MOG shall be contacted to provide suggestions for minimizing potential impacts to FTHLs. The cumulative new disturbance per MA since 1997 may not exceed 1% of the total acreage on federal land. The 1% cap on new surface disturbance within MAs will remain in effect for 5 years, after which the 1% cap will be reviewed by the MOG and amended, if necessary, based on more recent information. Each agency may permit disturbances of up to 1% of the land that the agency manages within the MA. Additions to the 242 Well Field by the BOR and existing, on-going activities at DOD facilities (for MCAS-Yuma, these activities are described in the EIS for the Yuma Training Range Complex) do not count towards this 1%. If disturbance greater than the 1% cap is desired, the agency may request use of the 1% disturbance allowance of other signatory agencies in the MA. All authorizations must be conducted in accordance with applicable mitigation and compensation.

2.2.2 All federally owned lands in the MAs shall be retained in federal ownership (except the patenting of mining claims pursuant to the General Mining Law of 1872). Lands in MAs owned by the state of California and managed as preserves, refuges, or parks shall be retained in state ownership.

2.2.3 Maintenance of all existing ROW facilities may continue within MAs.

2.2.4 The proposed Area Service Highway and its ROW are outside of the Yuma Desert MA. This and other new road construction along the boundary of the Yuma Desert MA shall require fencing to reduce access to the MA and lizard exclusion fencing (Appendix 7) to reduce lizard mortality.

2.3. Limit and/or reduce surface disturbance in MAs from discretionary minerals actions.

2.3.1 Allowable activities are the following: 1) leasing under the mineral leasing laws with no surface occupancy; 2) development and production in existing mineral material extraction sites in accordance with local, state, and federal laws and land-use plans, and subject to applicable mitigation; 3) new leases and permits for geothermal energy with stipulations of no surface occupancy (in California MAs only); and other mining and exploration activities authorized under the General Mining Law of 1872. Replacement wells and operation and maintenance of facilities shall be allowed on existing leases. The activities listed above shall be subject to applicable Mitigation (p. 60) and Compensation (p. 62).

2.4. Limit vehicle access and limit route proliferation within MAs.

2.4.1 Reduce new road construction to a minimum by coordinating access needs and avoiding conflicts and replication in road use, development, and management. Allow maintenance of roads on a case-by-case basis, recognizing that maintenance of some roads may be necessary to prevent proliferation of parallel routes. Any new surface disturbance associated with road maintenance shall require mitigation.

2.4.2 All routes shall be designated either "closed" to motorized vehicles, "open" for general public use by all types of vehicles, or "limited" to a specific season, user, or vehicle type or number. Vehicle use shall be restricted to designated open and limited routes. Routes in MAs shall be given a high priority for signing. Routes shall be considered “closed” unless signed as “opened” or “limited”.

2.4.3 Reduce open and limited route density in MAs, particularly in portions of MAs where route density is high.

2.4.4 Participating land managers shall coordinate with the U.S. BP to ensure cooperation with and enforcement of vehicle regulations in MAs and the RA to the maximum extent possible. Coordination shall include regularly scheduled meetings among signatory agencies and U.S. BP in the Yuma and El Centro Sectors to discuss management issues and ways to resolve those issues.

2.5. Limit the impacts of recreational activities within MAs.

2.5.1 All types of vehicle-oriented recreation in compliance with current regulations may occur within the RA.

2.5.2 Permit no competitive motorized vehicle recreational events within MAs. A competitive event is any event where speed or elements of competition (i.e., winning) are present in any form. Non-competitive events may be allowed on routes designated open for public use during the FTHL season of hibernation. Other types of vehicle-based recreation except camping (see action 2.5.4) in compliance with current regulations may occur within MAs.

2.5.3 Allow currently authorized non-motorized recreational activities, such as rock hounding, hiking, backpacking, non-vehicle based camping, picnicking, bicycling, horseback-riding, hunting, bird watching, and nature study, in all MAs and the RA in accordance with existing regulations. Development of new recreational facilities, such as visitor centers, campgrounds, mountain bike trails, equestrian trails, shall not be allowed within MAs, if these would create new surface disturbance in excess of 1%. Installation of interpretive signing and informational kiosks is allowed.

2.5.4 Allow vehicle-based camping only in developed campgrounds, designated camping areas, or within 50 feet from centerline of a designated open route within MAs. More restrictive measures may apply in certain areas. Non-vehicle camping may occur anywhere.

2.5.5 No long-term camping areas shall be designated or developed in MAs.

2.6. Authorize limited use of plants in MAs.

2.6.1 Make no sales and allow no commercial collecting of native plant products (including whole plants, plant parts, flowers, and seeds) within MAs, except as needed for rehabilitation projects within the MAs.

2.6.2 Authorize no livestock grazing in the MAs.

2.7. Within the MAs, allow off-road military maneuvers and encampments only in designated sites. Allow other military activities on previously disturbed lands managed by DOD agencies consistent with normal operations and functions. Marine Corps activities on the BMGR shall be governed by Conference Opinion 2-21-95-F-114, dated April 17, 1996 (USFWS 1996a), as amended, whether or not the species is listed. This Conference Opinion is consistent with the goal and management objectives set forth in this RMS.

2.8. Suppress fires in MAs and the BLM-administered lands in the RA using a mix of the following methods: 1) aerial attack with fire retardants, 2) crews using hand tools to create fire breaks, and 3) mobile attack engines limited to public roads, designated open routes, and routes authorized for limited-use. Do not allow earth-moving equipment (such as bulldozers) except in critical situations to protect life, property, or resources. Post-suppression mitigation shall include rehabilitation of firebreaks and other ground disturbances using hand tools.

2.9. No pesticide treatments shall be applied within MAs. Use of specifically targeted, hand-applied herbicides (e.g. for tamarisk eradication projects) is allowed.

2.10. Within MAs, other discretionary land uses and activities not consistent or compatible with the above restrictions and the general RMS shall not be approved by the authorizing agency.

3. Within the MAs, rehabilitate damaged and degraded habitat, including closed routes and other small areas of past intense activity. Methods to be used may include, but are not limited to, a) ripping or scarifying compacted soils, b) recontouring the surface, c) pitting or imprinting the surface, d) seeding with native plants, e) planting seedlings, f) irrigating, and g) barricading. See Habitat Rehabilitation on page 69 for additional information.

4. Attempt to acquire through exchange, donation, or purchase from willing sellers all private lands within MAs.

4.1. Establish and maintain with approval of the MOG (see Planning Action 6.1.1) a prioritized list of parcels or screening criteria for acquisition within each MA and habitat corridor.

4.2. Seek funding to acquire key parcels within MAs.

4.3. Using compensation and other funds, acquire land within MAs in accordance with established priorities and/or criteria.

4.4. Participate in exchanges where opportunities arise to acquire key parcels within MAs.

5. Maintain or establish effective habitat corridors between naturally adjacent populations.

5.1. Activities in potential habitat corridors between MAs and the RA shall be regulated or mitigated so that at least occasional interchange of FTHLs occurs among adjacent populations. Potential habitat corridors include lands between West Mesa and Yuha Desert MAs and between West Mesa MA and Ocotillo Wells RA (see Corridors). In addition, activities in the Yuha Desert and Yuma Desert MAs that would prevent interchange of FTHLs across the International Border shall be prohibited.

5.2. Coordinate conservation efforts with Mexico and the Immigration and Naturalization Service to ensure continued movement of FTHLs across the International Border in the Yuha Desert and Yuma Desert MAs.

6. Coordinate activities and funding among the participating agencies and Mexican agencies.

6.1. Maintain information exchange and coordination of monitoring, management activities, and research.

6.1.1 Maintain a FTHL MOG consisting of management representatives from agencies participating in the conservation agreement (see Planning Action 6.2). The FTHL MOG shall provide management-level leadership, coordination, and oversight in the implementation of this RMS. The FTHL MOG shall review progress in implementing the conservation agreement, approve amendments to the RMS, set priorities, and recommend measures to resolve management issues relevant to implementation of the RMS. The FTHL MOG shall provide overall

policy guidance and coordination among the cooperators for the use of compensation funds.

6.1.2 Hold semi-annual meetings of the ICC. Each of the participating agencies shall designate a representative(s) to the ICC. Representatives from other agencies, organizations, and groups with special interests or knowledge of the FTHL may also be invited to ICC meetings. The ICC shall function as a forum for exchange of information on research results and proposals and for discussion of technical and management issues. The ICC may be assigned specific duties and responsibilities by the FTHL MOG.

6.1.3 Develop a forum for discussions with agencies and individual counterparts in Mexico to coordinate activities, provide information exchange, and promote and assist in development of a FTHL conservation program in Mexico.

6.2. Confirm commitment of agencies participating in this RMS through development and signing of a conservation agreement.

6.3. Incorporate management actions from this RMS when developing multi-agency, multi-species ecosystem plans for the ecoregions in the range of the FTHL incorporating management actions from this RMS.

6.3.1 Incorporate actions in the development of the Western Colorado Desert Coordinated Management Plan (including the Yuha Desert, West Mesa, East Mesa, and Borrego Badlands MAs and Ocotillo Wells RA).

6.3.2 Incorporate actions in the development of the CVMSHCP.

6.3.3 Incorporate actions in the development of the Western Colorado Desert Route Designation.

6.4. Coordinate with the BP in developing mutual agreements for the conservation of natural resources.

6.4.1 Encourage use of techniques that minimize BP OHV activity, such as remote cameras and vehicle barriers.

6.4.2 Prepare an educational presentation for briefing BP agents.

7. Promote the purposes of the strategy through law enforcement and public education.

7.1. Provide law enforcement in MAs and the Coachella Valley FTHL conservation areas sufficient to ensure compliance with OHV and other regulations as described in the planned actions.

7.2. Public information and education about the MAs and RA, including but not limited to interpretive signs and brochures, shall be made available to the public at the offices and interpretive centers of the participating agencies. Information provided shall describe the purposes of the MAs, the RA, and conservation areas within the Coachella Valley, and shall list all pertinent regulations.

8. Encourage and support research that will promote the conservation of FTHLs or desert ecosystems and will provide information needed to effectively define and implement necessary management actions. Research should be encouraged both

within and outside of MAs and the RA. Planning actions 8.3 and 8.4 shall be emphasized, as recommended by the ICC.

8.1. All research shall be conducted under permit from the land management agency. Permits from the state game and fish agency may also be required, and from the USFWS if the species is listed.

8.2. The OWSVRA shall continue to budget for research for at least 5 years. A team of scientists and managers will recommend research designs. Results shall be distributed to other land management agencies.

8.3. Continue to refine cost-effective techniques for assessing FTHL abundance.

8.3.1 Test trapping webs and other techniques to enumerate FTHLs directly.

8.3.2 Determine effectiveness of relative enumeration techniques as an index of relative abundance using test plots of known density.

8.4. Determine the following life history and demographic parameters and how they vary with environmental conditions:

- Age-specific mortality
- Longevity
- Clutch size
- Age-specific number of clutches per year
- Hatching success
- Recruitment
- Diet
- Home range size

8.5. Determine effects of the following activities and factors on FTHL demographics and habitat:

- Paved roads and highways
- OHV use and associated activities
- Geothermal development
- Pesticide Use
- Predation
- Non-native plants
- Fire
- Wind turbines

8.6. Determine genetic variation among populations and the effects of barriers on movements.

8.6.1 Determine genetic variation in populations in the different MAs.

8.6.2 Determine effects of human-created barriers such as railroads, canals, paved roads, agricultural fields, and extensively denuded areas.

8.6.3 Determine effects of natural barriers, such as the Colorado River.

8.7. Determine the effectiveness of the proposed mitigation measures.

9. Continue inventory and monitoring.

9.1. Continue to inventory lands within the range of FTHLs to clarify current range and habitat use.

9.2. Monitor habitat quality and population trends in five MAs, and additional MAs as designated, to determine progress toward overall management goal.

9.2.1 The ICC shall monitor implementation of this strategy.

9.2.2 Land management agencies shall monitor regional population trends using standardized techniques (see Appendix 4 and Appendix 5). Each MA shall be monitored using mark-recapture technique to estimate FTHL population size and determine a confidence interval, at least once every three years.

9.2.3 Land management agencies shall document habitat disturbance and loss; recording cumulative totals for percent and acreage of habitat lost. Land management agencies shall document a running total of compensation funds collected to date.

9.2.3.1 Signatory agencies shall conduct aerial reconnaissance and analysis of surface disturbance on the five MAs every five years.

9.2.4 The ICC shall prepare an annual report of monitoring results and progress on implementation of this RMS. The annual report shall be presented to the MOG for review and approval by the end of February each year and shall document implementation of Planning Actions in the previous calendar year. The report shall include a schedule of activities to be accomplished in the current calendar year, budget needs for the next fiscal year, and outyear budget needs for major projects. The report shall also include a summary of monitoring results and a discussion of the likely causes of any noted declines. Recommendations for reversing anthropogenic declines shall be made.

9.2.5 New inventory, monitoring, and research data shall be used in evaluations of the RMS and in assessing proposed changes to the RMS.

Summary of Management Strategy Implementation, 1997-2002

This section summarizes the implementation of Planning Actions identified in the 1997 edition of the RMS. It covers the period from May 1997 through June 2002. Details of items listed in this section can be found in the ICC annual reports that were completed during this period.

1. Delineate and designate flat-tailed horned lizard MAs and a RA.

1.1-1.6. Five MAs and one RA were mapped and precise boundary descriptions completed (see Figure 4 through Figure 9 and Appendix 3). Measures identified in the RMS were implemented within areas mapped as MAs. BLM-El Centro and BLM-Yuma drafted a document to implement the RMS: *The Proposed Amendment to the California Desert Conservation Area Plan and the Yuma District Resource Management Plan to Expand the East Mesa* ACEC, *West Mesa* ACEC, *and Gran Desierto Dunes* ACEC *Boundaries and to Implement the Flat-tailed Horned Lizard*

Rangewide Management Strategy in Imperial County, California and Yuma County, Arizona. A draft EA is attached to the Proposed Amendment (EA No. CA-067-EA-1998-023). Public scoping meetings concerning this proposed amendment were held. Work is in progress to finalize the EA, complete the NEPA process, and legally designate the MAs.

1.7. Encourage development of a MA in the Coachella Valley. The ICC developed a map with recommended boundaries for a MA in the Coachella Valley. The map was submitted to the Science Advisory Committee to be considered for incorporation into the CVMSHCP (see 6.3.2). Areas designated for management of FTHL in the Coachella Valley would take into account habitat connectivity, current levels of degradation, and manageability. Rather than designate a separate FTHL MA in the Coachella Valley, signatories decided to support creation and management of the CVMSHCP **.**

2. Define and implement management actions necessary to minimize loss or degradation of habitat.

2.1. Mitigate and compensate project impacts through humane and cost-effective measures.

2.1.1. Apply mitigation measures. Appropriate mitigation measures were enforced for all authorized projects that impacted FTHLs or their habitat.

2.1.2. Require compensation for residual impacts. Compensation funds were required for most projects that had residual impacts to FTHL habitat. Funds collected totaled $9742 in 1997/98, $5262 in 1998/91, $45,372 in 1999/01, and $246,880 in 2001/02 (the last figure is for BLM-Yuma only). Some projects were not charged compensation. This occurred where mitigation measures eliminated residual effects, and in cases of unauthorized BP project impacts on FTHL.

2.2. Limit authorizations that would cause surface disturbance in MAs.

2.2.1. Attempt to locate projects outside MAs; limit discretionary land use authorizations and ROWs to 10 acres and 1% total per MA. Four projects in excess of 10 acres were authorized; these were 75.7, 31.4, 16.1, and 11.6 acres in size. Acreage and percent of the MA authorized for disturbance were 2.7 and 0.002 % in the Yuma Desert, 20.2 and 0.018 % in the East Mesa, 107.1 and 0.079 % in the West Mesa, 20.2 and 0.036 % in the Yuha Desert, and 0.0 and 0.000 % in the Borrego Badlands.

2.2.2. Federally owned lands in the MAs shall be retained in federal ownership. No disposal of **federal** lands within MAs occurred.

2.2.3. Maintenance in existing ROWs may continue. No action required.

2.2.4. Require fencing along Yuma Desert MA boundary road. Signatory agencies coordinated with Yuma Mesa Irrigation and Drainage District and Yuma County on plans to fence the south side of County 14th Street from Avenue 6E east to Avenue 16E. The fence would be along the northern boundary of the Yuma Desert MA, and is planned to consist of barbed wire and hardware cloth. Fencing will be required along the Area Service Highway.

2.3. Limit surface disturbance in MAs from minerals actions.

2.3.1. Allow approved minerals actions while applying applicable mitigation and compensation. In 1998, 10 acres were adversely affected. In 2001, an additional 8.17 acres were affected by mining in previously existing claims.

2.4. Limit vehicle access and route proliferation in MAs.

2.4.1. Reduce new roads to a minimum in MAs. No new roads were authorized in MAs. However, numerous roads have developed in some MAs through repeated unauthorized use by BP, OHV recreationalists, and/or smugglers.

2.4.2. Designate routes "open", "closed", or "limited". Give route signing a priority. Some closed routes have been signed as such on the boundary of the Yuma Desert MA. The only paved road in the Yuma Desert MA was posted with a 25-mph speed limit to reduce the chance of FTHL mortality. BLM-El Centro signed vehicle routes several times, but overall signing of the route network was incomplete. NAF-El Centro signed routes on their ranges to reduce FTHL mortality. [In January 2003, BLM-El Centro completed route designation for the Western Colorado Desert. All vehicle routes on BLM managed lands in Imperial County were designated as open, closed, or limited. BLM is actively seeking congressional and grant dollars to implement this designation through signing and enforcing open and limited routes and closing and rehabilitating closed routes.]

2.4.3 Reduce route density in MAs. No action. Route densities in some areas increased because of smuggler and BP traffic.

2.4.4. Coordinate with US BP to ensure cooperation and enforcement of vehicle regulations. ICC members held several FTHL orientation sessions with BP agents in the Yuma and El Centro sectors to reduce impacts to FTHL habitat along the International Border. These briefings were designed to familiarize BP agents with FTHL natural history, habitat requirements, and the importance of minimizing vehicular traffic off of designated patrol routes/roads. These briefings were well received by BP personnel. BLM-El Centro implemented an aggressive education strategy with BP to reduce impacts to FTHL habitat. This education included Detailer and Post Academy Orientation in which detailers and new employees assigned to the El Centro sector were given a 1-2 hour presentation on the location of MAs, desert ecology, sensitive species, and how FTHL habitat is affected by off-route travel, including information relating to prey, ecology, and habits of the FTHL. BP representatives attended several MOG meetings, during which the issue of off-road travel was discussed. BLM-El Centro and BP held monthly coordination meetings.

2.5. Limit impacts of recreational activities in MAs.

2.5.1. Allow vehicle-oriented recreation in RA. No action required.

2.5.2. Permit no competitive recreation events in MAs. Competitive races have not been permitted in MAs. Prior to 1997, 6-12 races per year had been held in the West Mesa and Yuha Desert MAs.

2.5.3. Allow non-motorized recreational activities in MAs, but no new recreational facilities. No new recreational facilities were allowed in MAs.

2.5.4. Limit camping in MAs. A camping closure was implemented and enforced as mitigation in the East Mesa MA. This closure was signed and monitored and uses interpretive kiosks to educate the recreational community on FTHL habitat. No camping (or other public access) is allowed in the BMGR portion of the Yuma Desert MA.

2.5.5. No long-term camping areas shall be developed in MAs. None were developed.

2.6. Allow no sales or commercial collecting of plant products in MAs. No plant sales or commercial collecting were allowed.

2.7. Allow military maneuvers and encampments only in designated sites in MAs. Accomplished. A military staging area in the Yuma Desert MA was fenced to identify its location and limits so that adjacent areas would not be impacted.

2.8. Suppress fires in MAs and BLM lands in the RA using allowable methods. No fires occurred.

2.9. No pesticide treatments shall be applied within MAs. No pesticide treatments occurred.

2.10. Within MAs, other activities not consistent with the RMS shall not be approved. None were approved.

3. Rehabilitate damaged and degraded habitat in MAs. BLM-El Centro closed and rehabilitated several unauthorized vehicle tracks. Many of these received further vehicle impacts after being closed.

4. Attempt to acquire all private lands within MAs.

4.1 Maintain prioritized list of parcels for acquisitions. Lists prioritizing parcels for acquisition were maintained by the California OHV Division office headquarters in Sacramento and by BLM-El Centro. BLM-El Centro contacted all landowners within the East Mesa MA to advise them of BLM's desire to acquire their lands through purchase or exchange.

4.2 Seek funding to acquire key parcels in MAs. Compensation funds collected in California were banked for habitat acquisition.

4.3. Using compensation and other funds, acquire key lands in MAs. Acreage of habitat acquired in MAs and the RA is summarized in Table 1. DOD acquired approximately 15,500 acres of Arizona state land within the Yuma Desert MA, with DOD funding. All lands within this MA are now managed by signatory agencies. Private lands totaling 740 acres within and adjacent to the Borrego Badlands MA were acquired. BLM acquired 320 acres in the East Mesa and West Mesa MAs. Acquisitions of private lands totaling 8,936 acres were added to the OWSVRA RA.

4.4. Participate in exchanges to acquire key parcels in MAs. No opportunities for exchange arose.

Table 1. Private and state land acquired in MAs and the RA.

Agency	Acres	Location
Department of Defense	15,500	Yuma Desert Management Area
Ocotillo Wells District	8,936	Ocotillo Wells Research Area
Anza-Borrego State Park	740	Borrego Badlands Management Area
BLM El Centro	240	East Mesa Management Area
BLM El Centro	80	West Mesa Management Area
Total	**25,496**	

5. Maintain or establish effective habitat corridors between naturally adjacent populations.

5.1. Limit or mitigate activities in movement corridors. No projects were considered that would block movement across existing corridors between MAs.

5.2. Coordinate with Mexico and INS to ensure movement across the border. All corridors are currently intact to the best of our knowledge. No projects were considered that would block movement across the International Border.

6. Coordinate activities and funding among the participating agencies and Mexican agencies.

6.1.1. Establish a FTHL MOG. The MOG met three times per year to coordinate implementation of the conservation agreement in response to recommendations from the ICC. Meeting minutes were provided to all MOG and ICC members to facilitate effective coordination.

6.1.2. Hold semi-annual meetings of the ICC. The ICC met quarterly to discuss implementation of Planning Actions under the RMS and issues and challenges regarding implementation of the Planning Actions. In addition to ICC meetings, subgroups of the ICC met on occasion to discuss specific issues.

6.1.3. Develop a forum for discussions with agencies and individuals in Mexico. Directors of the Reserva de la Biósfera Alto Golfo de California y Delta del Río Colorado and the Reserva de la Biósfera el Pinacate y Gran Desierto de Altar cooperated with the ICC in furthering the knowledge and conservation efforts of the FTHL and its habitat. The Alto Golfo director hosted a meeting of the ICC at the Reserve's field station near El Golfo de Santa Clara, Sonora, and participated in one meeting in the U.S. A study, funded by BLM-Yuma and BOR was completed which investigated the status of FTHL in Sonora and Baja California del Norte (Rodríguez 2002), and developed interpretive materials (see 7.2 and 9.1).

6.2 Develop a conservation agreement. The conservation agreement was developed and was signed in June 1997. Signatories were AGFD; California Department of Parks and Recreation; NAF-El Centro; MCAS-Yuma; BLM, California and Arizona state offices; BOR, Lower Colorado Region; and USFWS, Region 1 and Region 2. The CDFG signed in July 1998.

6.3.1. Incorporate actions in Western Colorado Desert ecosystem plan. [BLM-El Centro designated all routes in the Western Colorado Desert as open, closed or limited in January 2003]

6.3.2. Incorporate actions into the CVMSHCP. BLM-Palm Springs participated in the development of the CVMSHCP. [This planning effort was ongoing as of January 2003. In addition, BLM-Palm Springs completed an amendment to the California Desert Conservation Area Plan in December 2002. Actions described in the RMS were incorporated into that planning decision and will be implemented on federal land in the Coachella Valley.]

6.4. Coordinate with U.S. BP to develop mutual agreements. In addition to the education efforts described in 2.4.4, coordination with BP occurred at multiple levels, and BP was represented at several MOG meetings.

7. Promote the purposes of the strategy through law enforcement and public education.

7.1. Provide sufficient law enforcement. AGFD, BLM, and MCAS-Yuma participated in off-road vehicle patrols in the Yuma Desert. Two MCAS-Yuma law enforcement positions were filled in April 2001 for the west side of the BMGR to help prevent illegal off-highway activity. ABDSP law enforcement rangers enforced regulations in the Borrego Badlands MA. Insufficient law enforcement was available to prevent illegal OHV traffic and illegal dumping in the West Mesa, Yuha Desert, East Mesa MAs, and the BOR portion of the Yuma Desert MA. [As of January 2003, BLM-El Centro was filling vacant law enforcement positions and applying for grants to add two additional rangers.]

7.2. Provide public information and education about the MAs and RA. FTHL signs were placed along roads within the East Mesa MA as compensation for a pipeline project. FTHL signs were posted at most access points into the Yuma Desert MA; however, most were subsequently stolen. BOR conducted information workshops and survey training for maintenance staff and other interested parties. Information brochures addressing the FTHL were prepared by staff from OWSVRA, printed in both English and Spanish, and were distributed to other agencies, their staffs, and the public. Funding for these brochures was provided by BOR and BLM. MCAS-Yuma developed a wallet-sized photo information card addressing the FTHL and distributed the card to key personnel working on BMGR. All users of BMGR received a briefing that included information on the FTHL, slides, pictures and/or descriptions. BLM-El Centro completed a range-user brochure and wallet cards to educate all range users of the presence of FTHL and correct procedures to avoid impacting lizards or to report any accidental impacts to lizards. The brochures and wallet cards were distributed to all range users. NAF-El Centro also produced brochures and wallet cards. During the 2001 and 2002 Yuma Birding and Nature Festivals, an ICC member presented one-hour seminars on the biology and conservation of the FTHL and hosted field trips to the Yuma Desert MA. FTHL ecology and habitat, the conservation agreement, and cooperative efforts of the participating agencies were highlighted during the seminars and field trips, all of which were well attended and well received by the public. Rorabaugh *et al.* (2000) presented a paper at a symposium entitled Creative Cooperation in

Resource Management in which they described the multi-agency conservation agreement to implement the RMS for the FTHL. AGFD and USFWS met with the Tucson Herpetological Society and other plaintiffs in a suit against USFWS regarding their 1997 decision to not list the FTHL. This meeting provided an opportunity to better explain the position of AGFD and USFWS regarding the status of the FTHL and the decision to not list it. Preservation of FTHL habitat was a priority issue in discussions with the Yuma Mesa Irrigation and Drainage District, BOR, BLM-Yuma, MCAS-Yuma, and the city of Yuma regarding development in the Foothills and the inclusion of this area into the water district. AGFD coordinated with Yuma city and county planners in the Growing Smarter and open spaces initiatives in Arizona. Discussions included the funding of habitat enhancement/acquisition and the potential for creating FTHL reserves outside the MA. With funding provided by BOR and BLM, Centro Intercultural de Estudios de Desiertos y Océanos worked with the education departments of the Alto Golfo and Pinacate Reserves to develop a brochure that informed visitors about the FTHL, biological features of the Gran Desierto de Altar, and the habitats and potential threats to FTHLs in Mexico (Rodríguez 2002). In addition, the brochure included specific information on regulations and recommendations for people to help protect FTHLs. Signs were developed to place in strategic areas in the reserves and along their borders, particularly areas close to railroad routes, roads frequented by locals, and roads accessing ejido lands.

8. Encourage and support research to promote conservation of FTHL and desert ecosystems.

8.1. Require permits for research. AGFD and CDFG continued to require a scientific collecting permit for any person who handled a FTHL. The AGFD issued 21 permits during this reporting period and CDFG issued seven through June 2001.

8.2. OWSVRA shall continue to budget for research. OWSVRA funded four studies (Young 1999; Setser and Young 2000; Setser 2001; T. Gardner 2002) to collect information on demographics, habitat use, and effects of OHV activity (see 8.4 and 8.5). The Ocotillo Wells District funded genetic and relative abundance studies by Utah State University researchers during the 2002 field season.

8.3. Develop a cost-effective technique for assessing FTHL abundance.

8.3.1. Test trapping and other techniques to enumerate FTHLs directly. ICC members consulted with Dr. David Anderson, a statistician from Colorado State University, regarding the practicality of monitoring FTHL population trends. Colorado State University statisticians developed a proposal for a trapping web design, which uses 97 pit fall traps arranged along 8 lines radiating from a central point. The theory is based on distance sampling, and the statistics of importance are the distances from the center of the web to the traps containing FTHL. Based on capture rates of FTHLs in pit fall traps reported by other studies, the authors recommended establishing 10-15 webs in each MA to achieve desirable sample sizes. ICC members established a trial trapping web in the Yuma Desert MA to test methods and materials, and to help evaluate whether this technique could produce the minimum of five captures per web calculated to be required to estimate

densities and trends. The web was operated in May and September of 2000, 2001, and 2002. Total captures were four, five, five, and four, respectively. A proposal to implement a full-scale trapping web was prepared by the ICC for submittal to funding sources. Young and Young (2000) used intensive tracking techniques to estimate densities in the Yuma Desert MA. Their estimates ranged from 0.5 lizards per hectare during drought conditions to 5.1 lizards per hectare in a good year. They believed that this variability, resulting from variable weather patterns, would be problematic for use in trends analysis. They estimated a minimum population of 28,000 FTHLS on the BMGR in 1996. A proposal to evaluate detection by dogs was drafted and is being finalized. A survey that uses mark/recapture methodology to estimate populations was developed and implemented by BLM-El Centro (Grant *et al.* 2001). It yielded a crude abundance estimate of 1.9 lizards per hectare (95% CI: 1.08 to 3.91 lizards/ha). [In the summer of 2002, the protocol was modified to provide a more robust estimate. This effort resulted in the best MA population estimate to date. The population of FTHLS in the Yuha Basin MA was estimated at 18,494 adults (95% CI = 14,596-22,391) and 8,685 juveniles (95% CI =6,860-10,510). "Adults" included all individuals over 60 mm SVL, while juveniles included all individuals less than 60 mm SVL (Wright and Grant 2002). This method is presented in Appendix 4.]. A presence/absence survey protocol was developed for determining distribution in Mexico (Gardner *et al.* 2001), and a modified version of that protocol is proposed for monitoring distribution in MAS (Appendix 5).

8.3.2. Determine effectiveness of direct enumeration techniques and scat counts as an index of relative abundance. Young and Young (2000) tested pitfall traps, walking surveys, driving surveys, and tracking for their effectiveness in surveying FTHL. Tracking and driving were the most successful.

8.4. Determine life history and demographic data. Young and Young (2000) captured 499 individual FTHLS in Arizona, and fitted 80 with radio transmitters to track movements and habitat use. They made comparisons between FTHLS and desert horned lizards, and between drought years and a wet year. Growth, longevity, predation, home range, habitat use, and behavior were investigated. Setser and Young (2000) caught, measured and marked 95 FTHLS at OWSVRA. They compared growth rates between years and with FTHLS captured in Arizona. They attached transmitters to 58 FTHLS to obtain home range and microhabitat use data. Comparisons were made between males, females, juveniles, and with Arizona FTHLS. They analyzed associations between FTHL habitat use and habitat features. Setser (2001) caught, measured and marked 121 FTHLS at OWSVRA. They compared the length, weight, and condition index between areas and between FTHLS caught in 1999 and 1998. They attached transmitters to 65 FTHLS to obtain home range and microhabitat use data. Comparisons were made between males and females. Gardner *et al.* (2001) x-rayed several gravid FTHLS for reproductive analysis. Gardner and Foley (2001) conducted a research study at NAF-El Centro to quantify availability and use of FTHL habitat at target areas. Weights were tracked through the course of the season and thread bobbins were used to evaluate use of different substrates by FTHLS and desert horned lizards. T. Gardner (2002)

captured a total of 82 individual FTHLs at OWSVRA in 2001 and placed transmitters on 49. Body condition and movements were monitored.

8.5. Determine effects of conflicting activities. A study at the Coachella Valley Preserve compared the invertebrate and reptile communities in an old vineyard and an undisturbed area (Cameron Barrows, CNLM, pers. comm.). Four FTHLs were caught in a regenerating vineyard, indicating their ability to use rehabilitated habitats. Nicolai and Lovich (2000) found that FTHL movements declined after an OHV race in the Yuha Desert. Setser and Young (2000) and Setser (2001) found a negative association between OHV disturbance and FTHL habitat use at OWSVRA. Based on qualitative observations, T. Gardner (2002) did not suggest that any differences in OHV activity had influenced the FTHLs at his study sites at OWSVRA. He did, however, recognize that some habitat factors (vegetation, sand availability) that appeared to differ between the sites may have been influenced by OHV activity. In addition, at OWSVRA, the district ecologist outfitted some individual lizards with radio-telemetry as part of a limited, ongoing study of the effects of OHVs on movement and home ranges. Wright and Grant (2002) determined that neither vehicle track coverage nor number of vehicle routes or roads were significantly correlated with FTHL numbers. However, plots with less than 9% vehicle track coverage had 3.5 times more FTHLs than plots with greater than 9% track coverage. Plots with a route or road on them did not have a significantly different number of FTHLs than plots without a route or road. They suggested that substrate characteristics played a greater role in affecting numbers of FTHLs than did vehicle traffic.

8.6. Determine genetic variation among populations and effects of barriers.

8.6.1. Determine genetic variation in MAs. Tissue samples (toe clips from live animals, plus liver and muscle from sacrificed animals) were obtained from FTHLs in the Yuma Desert MA in Arizona (Gardner *et al.* 2001) and several populations in California, including OWSVRA (Setser 2001; T. Gardner 2002), Yuha Desert (Dan Mulcahy, Utah State University, unpubl. data), East Mesa MA (Dan Mulcahy, unpubl. data; Gardner & Foley 2001), West Mesa MA (Gardner & Foley 2001), and Coachella Valley (Tanya Trepanier, unpubl. data). Tissues from scattered localities in Baja California del Norte and Sonora, Mexico were also obtained (Rodríguez 2002). Dan Mulcahy is conducting the analyses and anticipates completion of the findings in 2003 (pers. comm.)

8.6.2. Determine effects of human-created barriers. This was not investigated.

8.6.3. Determine effects of natural barriers. The genetic analyses described under 8.6.1 will allow an evaluation of the effects of the Colorado River and the Salton Sea Trough as potential natural barriers.

8.7. Determine effectiveness of mitigation measures. BLM-Yuma tested ¼- and ½-inch mesh fencing to determine its durability for potential use in excluding FTHLs from roads. They found that both sizes withstood burial from drifting sand, but the ½-inch mesh resulted in ensnarement and mortality of zebra-tailed lizards. Utah State University researchers installed test enclosures and found that FTHL are not likely to climb fences of either size mesh. Gardner *et al.* (2001) found that ¼-inch

mesh barrier fences were effective in reducing the number of FTHL entering the Auxiliary 2 road in the Yuma Desert MA. These findings were incorporated into a fencing protocol (Appendix 7).

9. Continue Inventory and Monitoring

9.1. Continue inventories. The area between I-10 and Dos Palmas was surveyed to determine if a corridor for FTHL existed there. Only desert horned lizards were found. The substrate was apparently too rocky and coarse for FTHL. Historic FTHL habitat in this area appeared to have been lost to agriculture. BLM-Yuma and AGFD completed a project to test Landsat imagery to predict FTHL occurrence. They found that the imagery could be used to predict with moderate accuracy areas of high to moderate lizard density. Areas with few or no FTHL could not be predicted with any accuracy, however. BLM-Palm Springs surveyed the area between the east end of Indio Hills and the Coachella Valley Preserve for FTHL and found none. These two populations were probably genetically isolated from one another. Due to the small area the Indio Hills population occupies (1,800 acres), its heavily impacted nature, and low population density, it is not believed to be viable in the long term. Surveys were conducted along fringe areas of the Borrego Badlands MA in the area of Clark Dry Lake, Font's Wash, and the western Borrego Badlands. These surveys added to our knowledge of documented FTHL range. FTHL were monitored for presence/absence on a provisional basis (pending the establishment of an effective protocol) at OWSVRA. With funding from BOR and BLM, an important study to investigate the distribution of FTHL in Sonora and Baja California del Norte was conducted. The Centro Intercultural de Estudios de Desiertos y Océanos, a binational non-governmental organization in Puerto Peñasco, Sonora, was contracted to conduct this study. The principal investigator worked closely with ICC members to develop a survey protocol, conduct surveys, and analyze the results. Cooperators in this project included the Reserva de la Biósfera Alto Golfo de California y Delta del Río Colorado, the Reserva de la Biósfera el Pinacate y Gran Desierto de Altar, and several ICC agencies. ICC members made several trips, totaling 43 person-days of effort, to assist with this project. New distributional records were obtained in Baja California, the Gran Desierto, and Alto Golfo. A database was developed in conjunction with these surveys for storing locality records of FTHL in Mexico, morphometric and habitat data, and time and date of encounters. An interim report was completed during this reporting period, and a final report was completed in July 2002 (Rodríguez 2002).

9.2. Monitor habitat quality and population trends in the MAs.

9.2.1. Monitor implementation of the RMs. Implementation has been monitored through the compilation of annual reports as required by 9.2.4 (ICC 1998; Henry 1999; Twedt and Wright 2002).

9.2.2. Monitor population trends. Trends in encounter rates for FTHL and their scat were analyzed using data collected from 1979 to 2001 on three MAs in California (Wright 2002). Each year from 1979 to 2001 (except 1981), sample sites were drawn at random or systematically from three areas in the eastern Yuha Desert,

West Mesa, and southern East Mesa MAs. Analysis of these data showed no significant trends in encounter rates of FTHL or their scat. However, given the potential observer and sampling biases, a minor trend (upward or downward) could not be ruled out. Extension of this work into 2002 in the eastern Yuha Desert showed a similar non-significant trend (Wright and Grant 2002). Observations of FTHL during the course of biannual reptile surveys at OWSVRA were recorded as part of regular monitoring. FTHL observations by staff during archeology surveys, ranger patrol, or in the course of maintenance duties were noted. MCAS-Yuma continued its long-term surveys of the Auxiliary 2 road to assess the number of road kills and to monitor population trends.

9.2.3. Document habitat disturbance and loss. Data forms were developed to facilitate standardized assessment and documentation of habitat disturbance and loss. The habitat impacts that were authorized are shown in Table 2. Narratives describing these impacts and significant impacts on state or private lands may be found within the ICC annual reports. The Navy contracted Tierra Data Systems to aerial photograph and digitally map the 5 MAs and the RA to document habitat loss and disturbance. This effort provided a baseline with which to compare future analyses of habitat condition. BLM-El Centro began to quantify the level of vehicular impacts to FTHL habitat in their resource area using a step-point method. This consisted of walking 2.5-mile triangular transects within randomly chosen sections and tabulating what was found at the point of the surveyor's toe every 20th step along the transect. Variables measured included plants, vehicular tracks, organic litter, human footprints, water bottles, piles of clothes, and campfires. These surveys were conducted in 2001 in southeastern and southern portions of the Yuha and East Mesa MAs, respectively. Approximately 10.5% of the southeastern portion of the Yuha Desert MA was found to be covered with vehicle tracks. About 4.8% of the southern half of the East Mesa MA was covered with vehicle tracks (Wright 2002). The number of vehicle routes crossed by 12 transects in the Yuha Desert MA declined by 45% from 2001 to 2002, probably due to unusually strong spring sandstorms and changes in BP practices (Wright and Grant 2002). A similar effort was conducted in the Yuma Desert MA, where vehicle tracks were found to cover 2.9% of the ground surface in the BMGR portion of the MA and 3.4% of the surface in the 5-Mile Zone portion (Rorabaugh *et al.* 2002).

9.2.4. **Prepare an annual report of monitoring results and implementation progress.** Two annual reports (ICC 1998; Henry 1999) and a biannual report (Twedt and Wright 2002) were produced that summarized monitoring and RMS implementation from July 1997 through June 2001. The 2001/2002 report was in preparation.

9.2.5. New data shall be used in evaluations of the RMS and in assessing proposed changes. The new information described in the planning actions above was relied upon heavily during the revision of this RMS.

Table 2. Acres of FTHL habitat authorized for impact on lands managed by signatory agencies.

Agency	Inside MA	Outside MA	Total[1]
Palm Springs BLM	0	40.6	40.6[2]
El Centro BLM	146.5	240.8	387.3
Yuma BLM	0	81.3	81.3
Naval Air Facility - El Centro	1	0	1
Marine Corps Air Station-Yuma	2.5	0	2.5
Anza-Borrego Desert State Park	0	0	0
Ocotillo Wells SVRA	0	0	0
Bureau of Reclamation	0.2	391	391.2
Total Acres	150.3	753.7	904.0

[1]Figures exclude impacts from casual OHV use, BP activity, and OHV racing.

[2]Disturbance was considered temporary on 38.6 acres and permanent on 2 acres.

Management Implementation Schedule, 2003-2007

Table Description

The following table displays the priority, responsible agency, estimated cost, and schedule for completing each Planning Action. Initiation of these actions is subject to availability of funds. Actions in the table are explained further in the corresponding Planning Actions.

The priorities indicated in the table are assigned the following definitions:

Priority 1: An action that must be taken in the near term to conserve the species and prevent irreversible population declines.

Priority 2: An action that must be taken to prevent significant declines in population or habitat quality.

Priority 3: All other actions necessary to meet the goals and objectives of this Strategy.

The following abbreviations and symbols are used in the implementation schedule:

ABDSP.....Anza-Borrego Desert State Park

AGFD .....Arizona Game and Fish Department

BLM .....Bureau of Land Management

BOR.....Bureau of Reclamation

ICC.....Interagency Coordinating Committee

CDFG.....California Department of Fish and Game

OWSVRA.....Ocotillo Wells State Vehicular Recreation Area

USFWS.....U.S. Fish and Wildlife Service

USMC.....U.S. Marine Corps

USN .....U.S. Navy

☑.....Task completed since 1997

☐.....Task not completed

⇨,↻.....Task ongoing

Management Strategy Implementation Schedule, 2003-2007

Status	Priority	Action number	Planned action	Duration (yrs)	Resp agency	Total cost ($000)	Cost estimates ($000) FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
		1.	**Delineate and designate FTHL MAs**								
☑	1	1.1	Designate Yuma Desert MA	2	BLM BOR USMC	0					
☑	1	1.2	Designate East Mesa MA	2	BLM USN	0					
☑	1	1.3	Designate West Mesa MA	2	BLM USN	0					
☑	1	1.4	Designate Yuha Desert MA	2	BLM	0					
☑	1	1.5	Designate Borrego Badlands MA	2	ABDSP	0					
☑	3	1.6	Designate Ocotillo Wells RA	1	BLM OWSVRA ABDSP	0					
☑	1	1.7	Designate conservation areas in Coachella Valley	2	BLM USFWS CDFG	0					
		2.	**Define and implement actions necessary to minimize loss or degradation of habitat**								
⇨	1	2.1.1	Apply mitigation measures	↻	ALL	0					
⇨	1	2.1.2	Require compensation	↻	ALL	25	5	5	5	5	5
⇨	1	2.2.1	Limit discretionary land uses authorizations and rows to 10 acres and 1% total per MA	↻	ALL	0					
⇨	1	2.2.2	Do not dispose of lands in MAs	↻	ALL	0					
⇨	3	2.2.3	Continue maintenance in existing ROWs	↻	ALL	0					
⇨	2	2.2.4	Require fencing along Yuma Desert MA boundary road	↻	ALL	0					
⇨	2	2.3.1	Limit surface disturbance from mineral activities in MAs	↻	ALL	0					
☑	2	2.4.1	Reduce new roads to a minimum in MA s	2	ALL	0					
☐	1	2.4.2	Designate routes "open," "closed, or limited." Give route signing a priority	2	BLM	200	50	90	20	20	20
☐	1	2.4.3	Reduce route density in MAs		See 2.4.2						
⇨	1	2.4.4	Coordinate with U.S. BP	↻	ALL	20	4	4	4	4	4
⇨	3	2.5.1	Allow OHV recreation in RA	↻	OWSVRA	0					
⇨	1	2.5.2	No competitive recreational events in MAs	↻	ALL	0					
⇨	2	2.5.3	Allow non-motorized recreational activities in MAs, but no new recreational facilities	↻	ALL	0					
⇨	2	2.5.4	Limit camping in MAs	↻	BLM	20	10	10			

Management Strategy Implementation Schedule, 2003-2007

Status	Priority	Action number	Planned action	Duration (yrs)	Resp agency	Total cost ($000)	Cost estimates ($000) FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
⇨	2	2.5.5	No new long-term visitor areas in MAs	↻	ALL	0					
⇨	3	2.6	Authorize limited use of flora in MAs	↻	ALL	0					
⇨	1	2.7	Allow military maneuvers and encampments only in designated sites in MAS	↻	USN USMC	0					
⇨	3	2.8	Suppress fires in MAS using limited fire suppression methods in MAs	↻	ALL	0					
⇨	1	2.9	Prohibit pesticide treatments in MAs	↻	ALL	0					
⇨	3	2.10	Limit other activities consistent with above	↻	ALL	0					
		3.	**Rehabilitate damaged and degraded habitat**								
⇨	2	3	Rehabilitate damaged and degraded habitat in MAs	↻	BLM BOR ABDSP USMC USN	200	40	40	40	40	40
		4.	**Bring all lands within MAs into public management**								
☑	3	4.1	Maintain prioritized list of parcels for acquisitions; and respect private rights	1	ALL	0					
☐	3	4.2	Procure funds for land acquisitions in MA s (37,600 acres of private lands acres in California MAs at $250 per acre)	↻	BLM CDFG ABDSP OWSVR A	9,400					
⇨	3	4.3	Use compensation funds to acquire key lands in MAs	↻	BLM CDFG ABDSP OWSVR A	20	4	4	4	4	4
⇨	3	4.4	Exchange lands opportunistically	↻	BLM	20	4	4	4	4	4
		5.	**Maintain or establish effective habitat corridors between naturally adjacent populations**								
⇨	2	5.1	Limit or mitigate activities in movement corridors	↻	ALL	25	5	5	5	5	5
⇨	3	5.2	Coordinate with Mexico and INS	↻	ALL	10	2	2	2	2	2
		6.	**Coordinate activities and funding among the participating agencies and Mexican agencies**								
☑	2	6.1.1	Establish FTHL MOG	↻	ALL	5	1	1	1	1	1
⇨	2	6.1.2	Hold semi-annual ICC meetings	↻	ALL	5	1	1	1	1	1
⇨	3	6.1.3	Establish forum for discussions with agencies and individuals in Mexico	↻	ALL	5	1	1	1	1	1

Management Strategy Implementation Schedule, 2003-2007

Status	Priority	Action number	Planned action	Duration (yrs)	Resp agency	Total cost ($000)	Cost estimates ($000) FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
☑	1	6.2	Develop Conservation Agreement	1	ALL	0					
☐	2	6.3.1	Incorporate actions in Western Colorado Desert ecosystem plan (Note: other state and local agencies will fill key roles)	3	ALL	750	20	300	250	200	
☑	2	6.3.2	Incorporate actions in CVMSHCP (Note: other state and local agencies will fill key roles)	3	BLM CDFG USFWS	600	300	200	100		
☐	2	6.3.3	Incorporate actions in Western Colorado Desert Route Designation	3	BLM						
⇨	1	6.4	Coordinate with U.S. BP and develop mutual agreements	2	BLM BOR	6	3	3			
⇨	2	6.4.1	Encourage use of techniques to minimize BP OHV activity	↻	BLM BOR	5	1	1	1	1	1
☐	2	6.4.2	Prepare educational briefing for BP agents	1	BLM BOR	5					
		7.	**Promote the purposes of the strategy through law enforcement and public education**								
⇨	1	7.1	Provide adequate law enforcement	↻	BLM CDFG AGFD	750	150	150	150	150	150
⇨	3	7.2	Provide public information and education	↻	ALL	25	5	5	5	5	5
		8.	**Conduct research necessary to effectively define and implement necessary management actions**								
⇨	3	8.1	Require permits for research	↻	ALL	5	1	1	1	1	1
⇨	2	8.2	OWSVRA shall continue to fund research	↻	OWSVRA	200	40	40	40	40	40
☐	2	8.3.1	Test trapping as a population census technique	2	ALL	170					
☐	2	8.3.2	Test direct counting methods	2	ALL		Included in 8.2 and 8.3.1				
☐	2	8.4	Determine life history and demographic data	2	ALL		Also included in 8.2 and 8.3.1				
☐	2	8.5	Determine effects of conflicting activities	5	ALL	300					
☐	3	8.6.1	Determine genetic variation in population	5	ALL	30					
☐	3	8.6.2	Determine effects of non-natural barriers	5	ALL	30					
☐	3	8.6.3	Determine effects of natural barriers	5	ALL	15					
☐	3	8.7	Determine effectiveness of mitigation measures	5	ALL	20					
		9.	**Continue inventory and monitoring**								

Management Strategy Implementation Schedule, 2003-2007											
Status	Priority	Action number	Planned action	Duration (yrs)	Resp agency	Total cost ($000)	Cost estimates ($000) FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
⇨	2	9.1	Continue inventories	↻	ALL	125	25	25	25	25	25
⇨	2	9.2.1	Monitor implementation	↻	ICC	40	8	8	8	8	8
⇨	2	9.2.2	Monitor population trends	↻	ALL (MCAS)	320 (70)	70	105 (35)	70	105 (70)	70
⇨	1	9.2.3	Document habitat disturbance and loss	↻	ALL	40	8	8	8	8	8
⇨	1	9.2.3.1	Conduct aerial reconnaissance and analysis of surface disturbance on the five MAs every five years	↻	ALL	50					
⇨	2	9.2.4	Prepare annual monitoring/implementation report	↻	ICC	20	4	4	4	4	4
⇨	1	9.2.5	Use new inventory, monitoring, and research data in evaluations and proposed changes	↻	ALL	0					

Habitat Management

Management Areas

Each MA is controlled by multiple agencies and may include private inholdings (Table 3). MAs were designed to include most FTHL habitat identified as key areas in previous studies, even though the absolute densities of FTHLs within the MAs were not known. MAs were proposed based upon accepted principles of good preserve design, utilizing the best information available at the time. MAs included as large an area as possible, but avoided extensive, existing and predicted management conflicts (e.g., OHV open areas). Conflicts that are localized in nature (e.g., sand and gravel mines, military bombing targets) were accepted within some of the MAs. The MAs are the core areas for maintaining self-sustaining populations of FTHLs in perpetuity. Legal descriptions of the MAs and the RA are provided in Appendix 3, and maps (Figure 4 to Figure 10) are provided below. Maps do not show existing OHV trails, which are extensive in some MAs, except for major trails at OWSVRA.

The prescriptions that guide the management of lands within the MAs (see Planning Action 2, pg 27) were designed primarily to reduce surface disturbance and to promote reclamation of areas, such as duplicate roads that are no longer needed.

Table 3. Overview of Acreage and Ownership of Management Areas.

Management Area[1]	Federal Non-military[2]	Federal Military	State[3]	Private	Total
Yuma Desert[4] (Figure 4)	16,200	114,800[5]	0	0	131,000
East Mesa (Figure 5)	99,900	8,500	0	6,900	115,300

West Mesa (Figure 6)	83,200	29,800	1,300	21,800	136,100
Yuha Basin (Figure 7)	57,200	0	0	3,000	60,200
Borrego Badlands (Figure 8)	0	0	36,500	5,900	42,400
Total	256,500	153,100	37,800	37,600	**485,000**

1 The existing Coachella Valley Preserve and Dos Palmas ACEC (not included in table) includes about 17,076 and 14,400 acres, respectively, administered by federal and state agencies and private organizations.

2 Includes lands administered by the BLM and BOR.

3 Includes lands administered by California Department of Parks and Recreation and California State Lands Commission

4 Pending designation of the proposed Area Service Highway. A portion of the Yuma Desert MA boundary will be formed by the Area Service Highway, if and when constructed (see Figure 4).

5 Lands administered by MCAS-Yuma

Other Lands

Ocotillo Wells State Vehicular Recreation Area

A RA was established in California (Figure 9) where FTHL research is encouraged and funded by the California Department of Parks and Recreation's Division of Off-Highway Motor Vehicle Recreation (Foreman 1997). The RA is about 77,000 acres in size. About 47,000 acres of the RA are owned by the state and 22,000 acres are owned by BLM, all of which are managed as OWSVRA. The State has applied to BLM under the Recreation and Public Purposes Act for transfer and patenting of all 22,000 acres of BLM land to OWSVRA. The State is also actively acquiring the remaining private lands (8,000 acres) within the RA.

OWSVRA is mandated to provide OHV recreation (free-play, racing, and touring) in a manner to sustain long-term use. Soil removal, artifact collecting, hunting, and shooting are prohibited within OWSVRA. No collecting of reptiles is allowed except under a scientific collecting permit issued by CDFG and approved by OWSVRA.

In 1991, an extensive wildlife survey and habitat protection plan (Kutilek *et al*. 1991; Wone *et al.* 1991) was completed in OWSVRA. The presence of FTHLs and the possibility of listing precipitated a study in 1994 (Wone *et al*. 1994) to develop methods for monitoring population trends in OWSVRA. In these studies, methods of monitoring FTHL population trends on permanent plots in OWSVRA and on control plots were assessed (Wone and Beauchamp 1995b; Wone *et al.* 1997). OWSVRA has since funded several studies (Young 1999; Setser and Young 2000; Setser 2001; T. Gardner 2002; Gardner in prep) investigating topics such as: demographics, habitat use (including investigation of the mud hills habitat type), movement patterns, and the effects of OHV activity on FTHLs and their habitat. OWSVRA has made a commitment to continue to support FTHL research through 2007.

Anza-Borrego Desert State Park

Lands within ABDSP are managed to conserve native plant and animal communities. Mining, soil removal, grazing, rock hounding, artifact collection, hunting, shooting, and other activities that could cause surface disturbances are prohibited in the park. FTHLs occur on an estimated 30,000 to 40,000 acres of the Park.

Within the 600,000-acre park, there is a system of primitive roadways about 500 miles in length. No vehicular activity is allowed off these roadways. Patrol rangers cite violators; the park's patrol aircraft provides backup. Designated roads that might impact sensitive natural or cultural

resources can be closed seasonally or permanently by order of the District Superintendent. OHVs are prohibited from park roads unless they are licensed for use on highways. This rule essentially excludes use of all-terrain vehicles, quad-runners, high performance two-cycle motorcycles, and most dune buggies.

All animal and plant life within ABDSP is protected. No collection of reptiles is allowed, with the exception of those taken under a scientific collecting permit issued by the park office. Reptile poaching takes place on paved roadways, but usually does not include FTHLs (ABDSP files; Mark Jorgensen, pers. comm.)

Coachella Valley

Upon completion, the CVMSHCP will protect approximately 44.5% of the remaining FTHL habitat in the valley. This plan has been in preparation approximately 7-8 years, and will likely be signed in 2003. The FTHL is a covered species in this plan. An earlier HCP, implemented in 1986 to provide protection for the Coachella Valley fringe-toed lizard, also provides protection for FTHL habitat in the valley. Several hundred acres of privately owned and currently occupied habitat remains adjacent and connected to protected habitat. These lands are currently at risk for development, but will be protected if there are willing sellers and funds available to purchase through the CVMSHCP (Barrows 2002). In addition to protections via the CVMSHCP, habitat for FTHL within Dos Palmas ACEC and other BLM-managed public lands in eastern Riverside County, are already in conservation status and will remain so.

In the mid 1980's, the Coachella Valley Preserve System was established primarily for conservation of the Coachella Valley fringe-toed lizard (*Uma inornata*). The BLM, USFWS, CDFG, California Department of Parks and Recreation, and The Nature Conservancy acquired major portions of the preserve system. The System consists of three units totaling about 20,114 acres (Coachella Valley Preserve - 17,076 acres; Willow Hole-Edom Hill Preserve - 1,863; and Indian Avenue Preserve - 1,175 acres). About 6,000 acres of the System contain suitable FTHL habitat (Figure 10). The USFWS holdings were designated the Coachella Valley National Wildlife Refuge System. BLM-administered lands were designated an ACEC in 1993. The CDFG lands were designated an Ecological Reserve. The CDPR manages the adjacent Indio Hills State Park in a manner consistent with the Preserve goals. An interim plan was prepared in 1986 by The Nature Conservancy; it was replaced by an updated, interagency management plan in 1995 (BLM *et al*. 1995). A preserve management team meets quarterly to discuss management activities. No vehicular traffic is allowed.

Dos Palmas ACEC

The Dos Palmas ACEC is located north of the Salton Sea community of North Shore and encompasses about 14,400 acres of federal, state, and private lands. Surveys for FTHL in the southern part of the ACEC in the late 1970's resulted in the discovery of FTHL near Bat Cave Buttes. No additional surveys have been conducted since the 1970's. The ACEC is managed cooperatively by an interagency management committee, consisting of representatives from BLM, CDFG, California Department of Parks and Recreation, CNLM, and USFWS, which meets quarterly to discuss management issues and directions. In 1998, BLM prepared an Ecosystem Management Plan for the ACEC and continues to implement that today. Vehicular traffic is limited to existing, designated routes. BLM-Palm Springs has requested funding in Fiscal Years 2004 and 2005 to conduct surveys at Dos Palmas and east toward the East Mesa MA in Imperial County.

Arizona Lands outside the Yuma Desert MA

On BLM and BOR FTHL habitat outside BMGR, OHV use is limited to existing roads and trails. Because BLM and BOR are signatories to this document, surface-disturbing projects are subject to mitigation and compensation as described in this document. The Arizona State Land Department has not developed a plan for the management of state of Arizona lands within FTHL habitat. The State Land Department is processing land purchase applications for state of Arizona lands east of Yuma and near San Luis.

Mexican Habitat

Although this strategy currently addresses habitat in the U.S. only, there are objectives and planned actions for establishing and maintaining contacts with appropriate agencies and personnel in Mexico to promote the conservation of FTHL habitat within Mexico. Agencies that have the authority to work with Mexico, including the AGFD, CDFG, USFWS, BOR, and BLM, have developed partnerships with agencies, researchers, and non-governmental organizations in Sonora, and will work to develop similar contacts in Baja California Norte. It is hoped that through these contacts and exchanges of ideas a similar management strategy will be adopted in Mexico. This program may include corridors between MAs in the U.S. and Mexico.

Lands in El Parque Nacional del Pinacate Cerro Pinto and the Sierra del Rosario in Sonora and near the delta of the Colorado River in Sonora and Baja California are in core protection zones of biosphere reserves (Reserva de la Biósfera de El Pinacate y Gran Desierto de Altar and Reserva de la Biósfera del Alto Golfo de California y Delta del Río Colorado). El Parque Nacional del Pinacate is an area administered by the Mexican government with use restrictions similar to a national park in the U.S. However, the boundaries are not well established, and enforcement of regulations is minimal. The Pinacate area is primarily a volcanic zone within which FTHL habitat is probably limited to the sandy perimeters of Volcán Pinacate. Reserva de la Biósfera Alto Golfo includes FTHL habitat in Sonora in the vicinity of the Colorado River Delta and the Gran Desierto.

Figure 4. Yuma Desert Management Area.

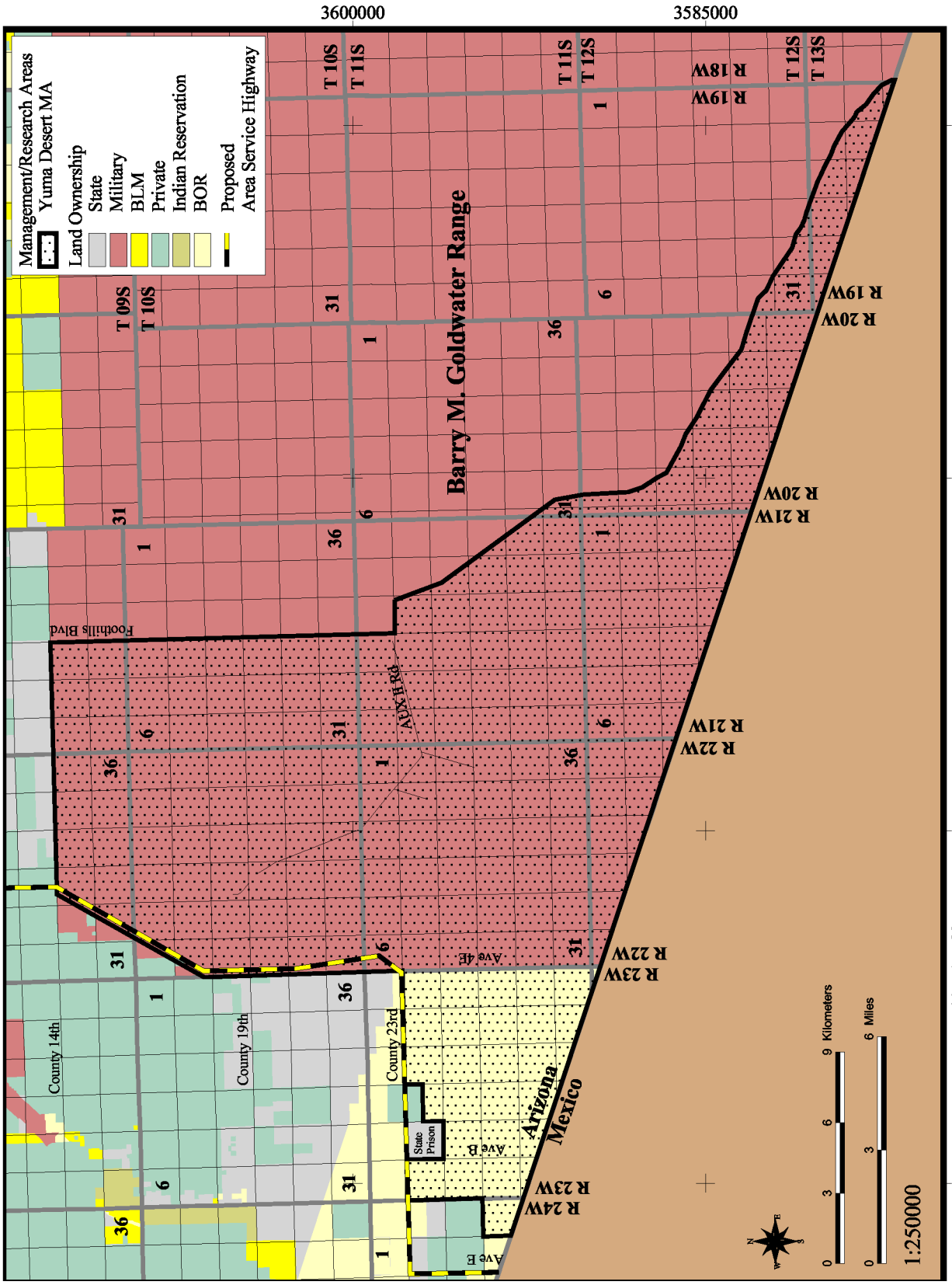


Figure 5. East Mesa Management Area.

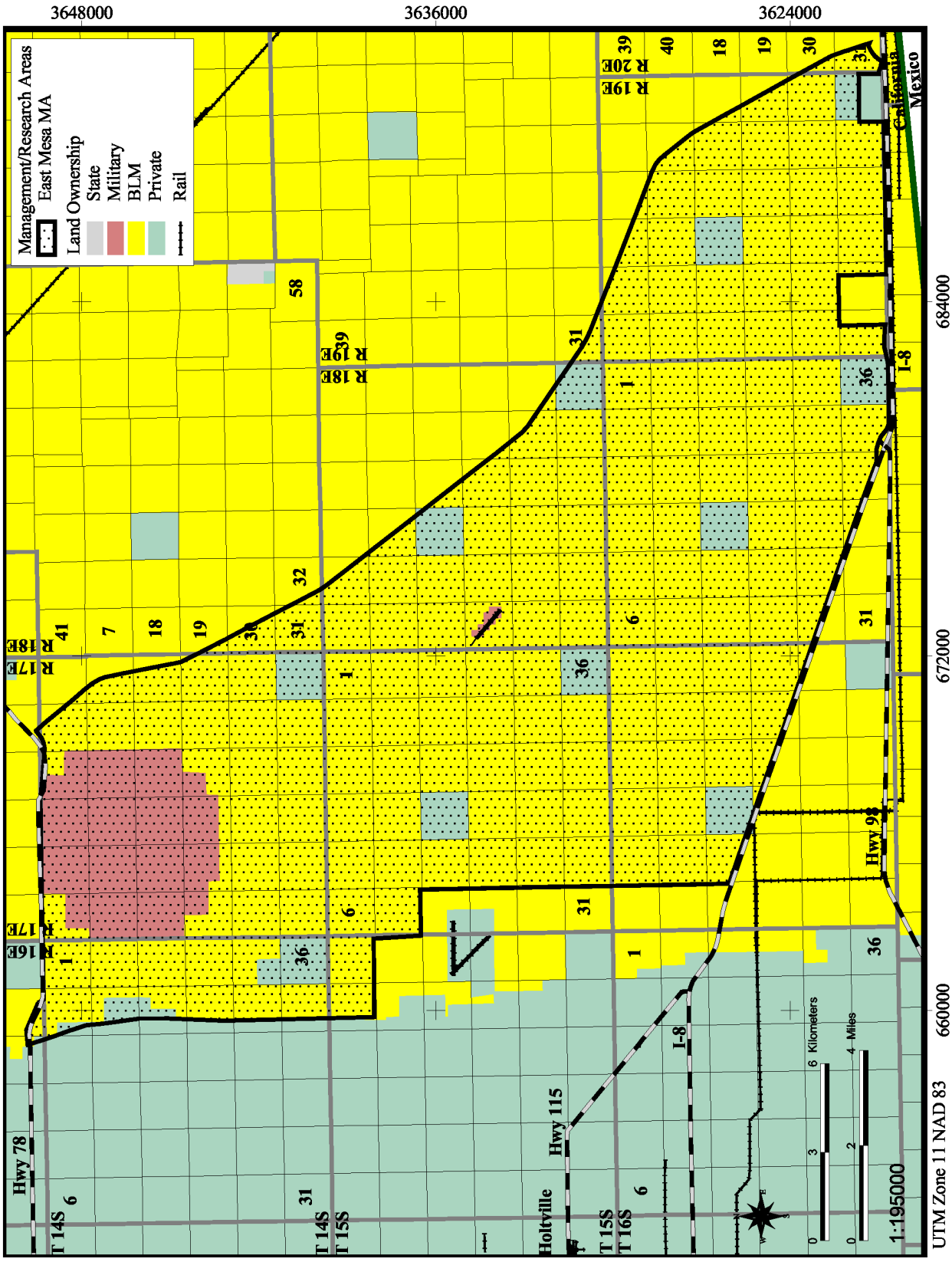


Figure 6. West Mesa Management Area.

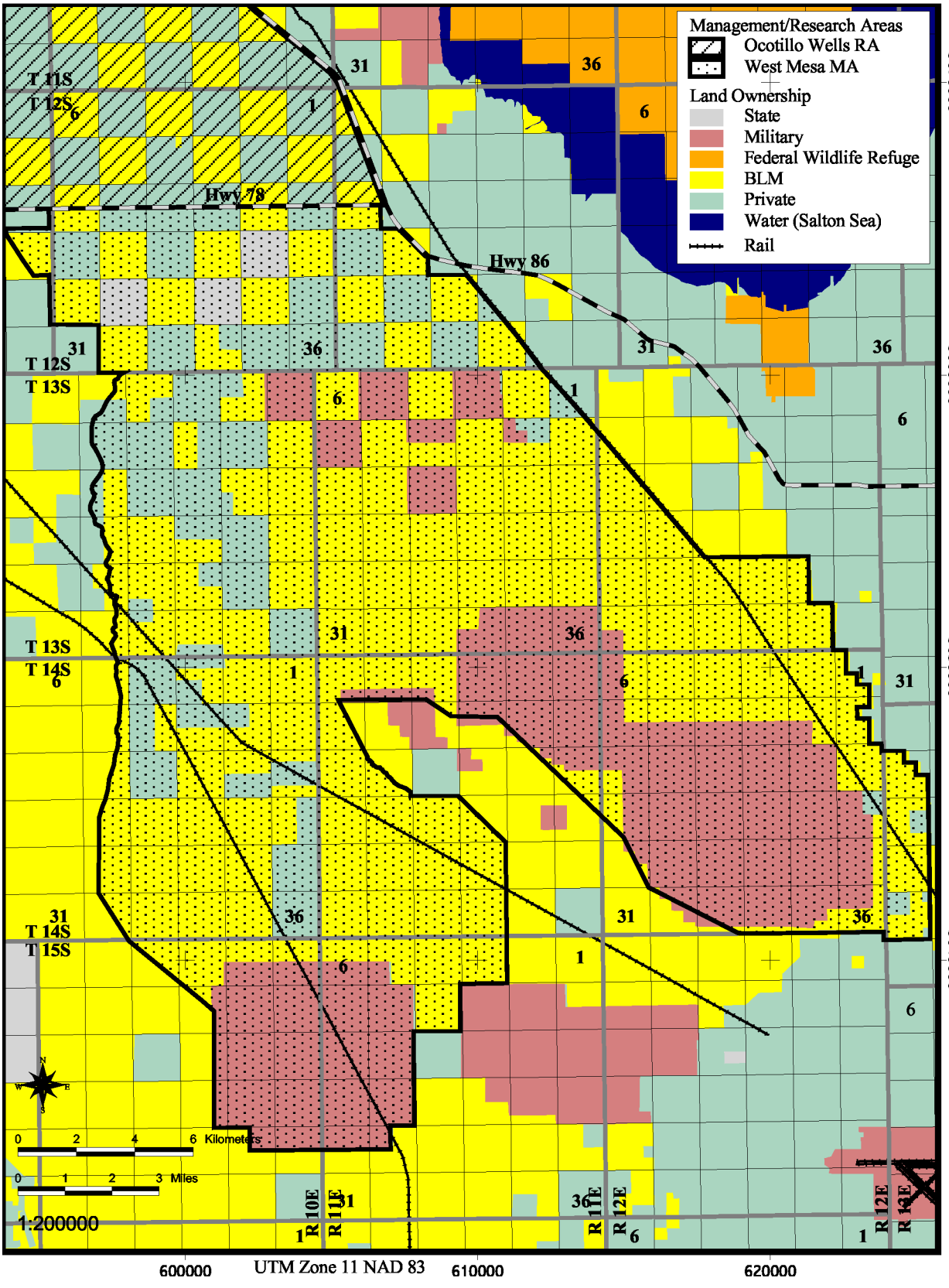


Figure 7. Yuha Desert Management Area.

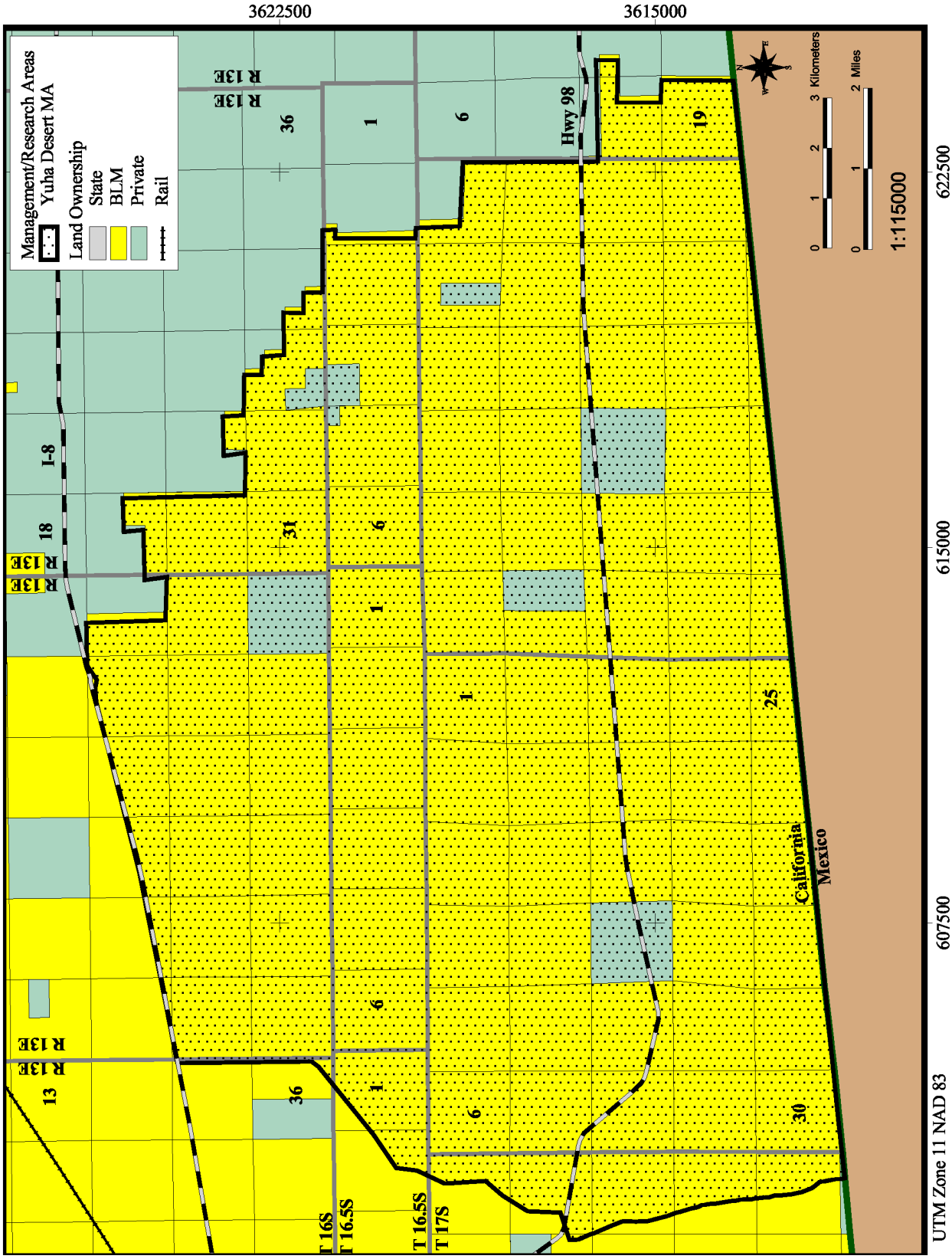


Figure 8. Borrego Badlands Management Area.

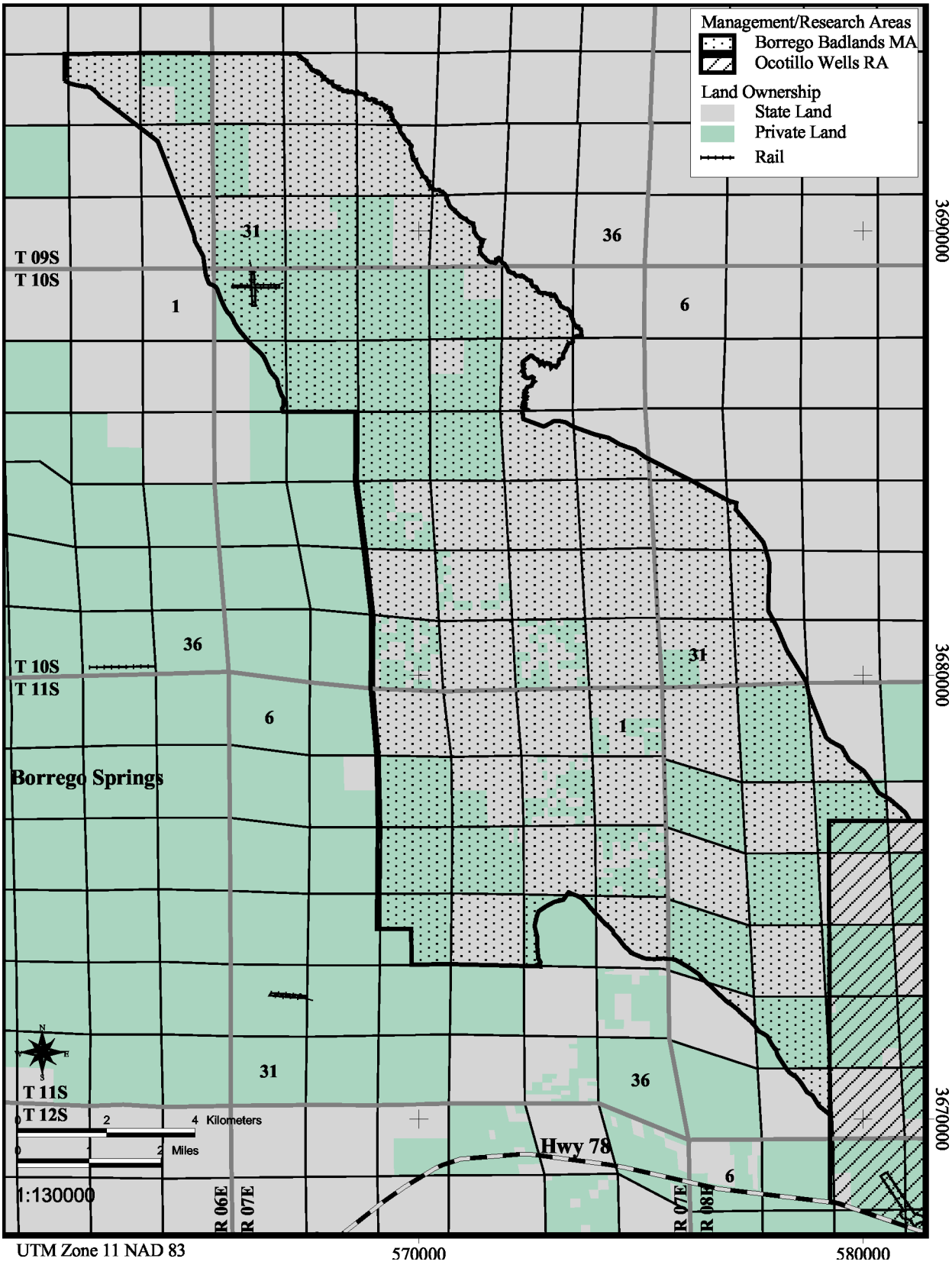


Figure 9. Ocotillo Wells State Vehicular Recreation Area Research Area.

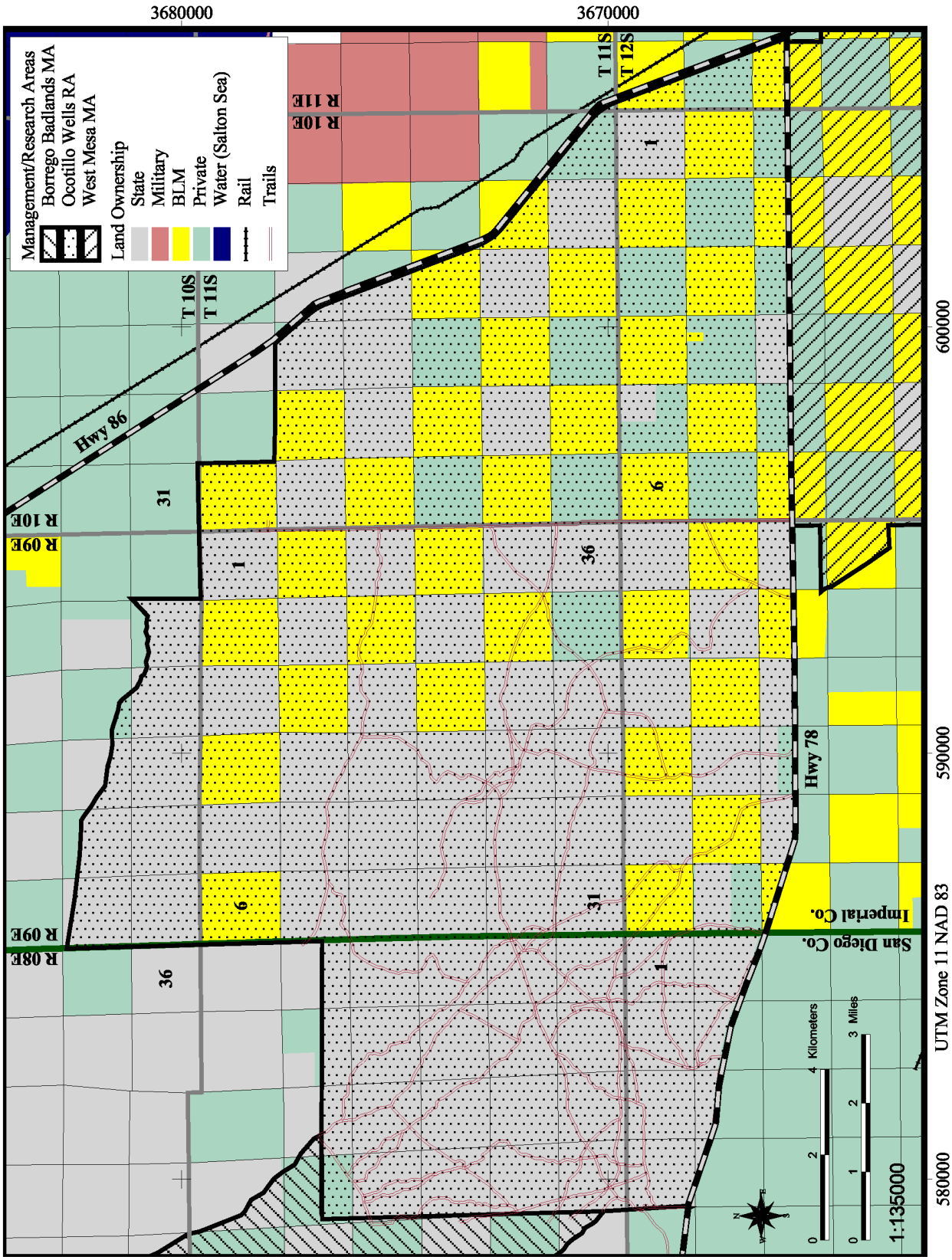
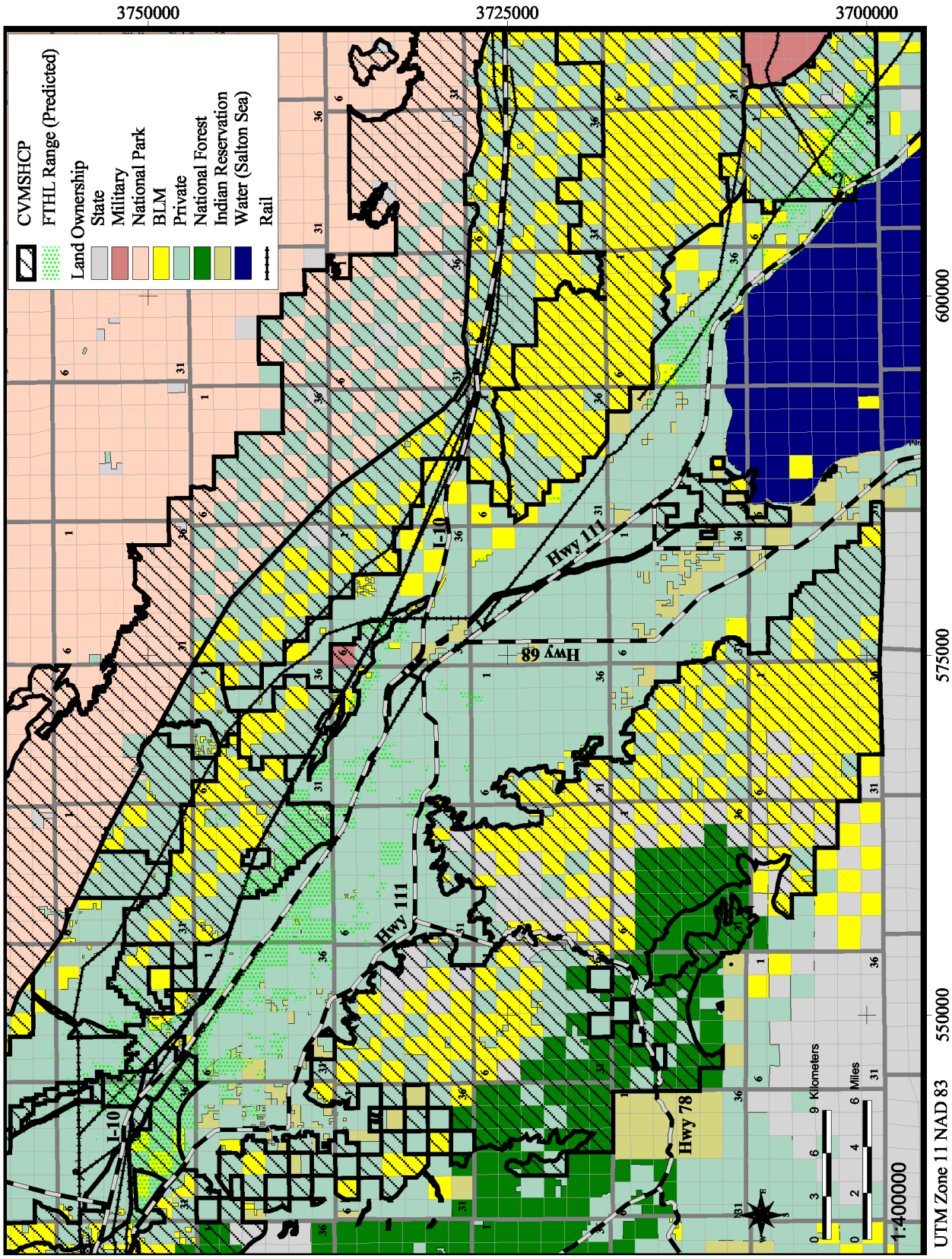


Figure 10. Coachella Valley Preserve System.



Mitigation

In accordance with Planning Action 2.1.1, the following mitigation measures shall be incorporated into all projects where applicable based on the Project Evaluation Protocol in Appendix 6. The measures are to be modified to conform to the nature of the project.

1. To the extent possible, surface-disturbing projects shall be located outside of FTHL MAs and the RA, and shall be timed to minimize mortality. If a project must be located within a MA or RA, effort shall be made to locate the project in a previously disturbed area or in an area where habitat quality is poor. A survey of the project site shall be conducted prior to construction in order to assist in locating the project.

2. Prior to project initiation, an individual shall be designated as a field contact representative. The field contact representative shall have the authority to ensure compliance with protective measures for the FTHL and will be the primary agency contact dealing with these measures. The field contact representative shall have the authority and responsibility to halt activities that are in violation of these terms and conditions.

3. All project work areas shall be clearly flagged or similarly marked at the outer boundaries to define the limit of work activities. All construction and restoration workers shall restrict their activities and vehicles to areas that have been flagged to eliminate adverse impacts to the FTHL and its habitat. All workers shall be instructed that their activities are restricted to flagged and cleared areas.

4. Within FTHL habitat, the area of disturbance of vegetation and soils shall be the minimum required for the project. [If possible, specify a maximum disturbance allowable based on the specifics of the project.] Clearing of vegetation and grading shall be minimized. Wherever possible, rather than clearing vegetation and grading the ROW, equipment and vehicles shall use existing surfaces or previously disturbed areas. Where grading is necessary, surface soils shall be stockpiled and replaced following construction to facilitate habitat restoration. To the extent possible, disturbance of shrubs and surface soils due to stockpiling shall be minimized.

5. Existing roads shall be used for travel and equipment storage whenever possible.

6. Where feasible and desirable, in the judgment of the lead agency, newly created access routes shall be restricted by constructing barricades, erecting fences with locked gates at road intersections, and/or by posting signs. In these cases, the project proponent shall maintain, including monitoring, all control structures and facilities for the life of the project and until habitat restoration is completed.

7. A biological monitor shall be present in each area of active surface disturbance throughout the work day from initial clearing through habitat restoration, except where the project is completely fenced and cleared of FTHLs by a biologist (see Measure 8). The biological monitors shall meet the requirements set in Appendix 6. The monitor(s) shall perform the following functions:

    a) Develop and implement a worker education program. Wallet-cards summarizing this information shall be provided to all construction and maintenance personnel. The education program shall include the following aspects at a minimum:

- biology and status of the FTHL,
- protection measures designed to reduce potential impacts to the species,
- function of flagging designating authorized work areas,
- reporting procedures to be used if a FTHL is encountered in the field, and
- importance of exercising care when commuting to and from the project area to reduce mortality of FTHLs on roads.

b) Ensure that all project-related activities comply with these measures. The biological monitor shall have the authority and responsibility to halt activities that are in violation of these terms and conditions.

c) Examine areas of active surface disturbance periodically (at least hourly when surface temperatures exceed 85ºF) for the presence of FTHLs. In addition, all hazardous sites (e.g., open pipeline trenches, holes, or other deep excavations) shall be inspected for the presence of FTHLs prior to backfilling.

d) Work with the project supervisor to take steps, as necessary, to avoid disturbance to FTHLs and their habitat. If avoiding disturbance to a FTHL is not possible or if a FTHL is found trapped in an excavation, the affected lizard shall be captured by hand and relocated.

8. Sites of permanent or long-term (greater than one year) projects in MAs where continuing activities are planned and where FTHL mortality could occur, may be enclosed with FTHL barrier fencing to prevent lizards from wandering onto the project site where they may be subject to collection, death, or injury. Barrier fencing should be in accordance with the standards outlined in Appendix 7. After clearing the area of FTHLs (also see Appendix 7), no on-site monitor is required (see Measure 7).

9. The project proponent shall develop a project-specific habitat restoration plan under approval by the lead agency. The plan shall consider and include as appropriate the following methods: replacement of topsoil, seedbed preparation, fertilization, seeding of species native to the project area, noxious weed control, and additional erosion control (see Habitat Rehabilitation, p. 69). Generally, the restoration objective shall be to return the disturbed area to a condition that will perpetuate previous land use. The project proponent shall conduct periodic inspection of the restored area. Restoration shall include eliminating any hazards to FTHLs created by construction, such as holes and trenches in which lizards might become entrapped. Disturbance of existing perennial shrubs during restoration shall be minimized, even if such shrubs have been crushed by construction activities.

10. Construction of new paved roads shall include a lizard barrier fence on each side of the road that is exposed to occupied FTHL habitat. Exceptions may occur in accordance with the following evaluation, to be applied separately to each side of the road. This prescription may also be applied to canals or other fragmenting projects.

Side is made nonviable for FTHLs even if connected to the other side:

- Compensate for the entirety of the fragmented parcel.

Side is viable only if connected to the other side:

- Compensate for the entirety of the fragmented parcel, or
- Provide fencing and effective culverts or underpasses that will maintain connectivity.

Side is viable even if not connected to the other side:

- Provide fencing (no culverts)

Specifications for barrier fences are provided in Appendix 7. The FTHL ICC will make the determination of FTHL population viability based on the size, configuration, and habitat condition of the isolated parcel, threats from adjacent lands, and existing scientific evidence of edge effects on FTHL. Culvert design will be provided by the FTHL ICC.

Compensation

Pursuant to Title 43 Code of Federal Regulations and the Federal Land Policy and Management Act of 1976, federal land management agencies may permit actions that result in FTHL habitat loss on their lands. To mitigate such losses both within and outside MAs, compensation is charged if residual effects would occur after all reasonable on-site mitigation has been applied. Signatories may use compensation funds to acquire, protect, or restore FTHL habitat both within and contiguous with MAs (with MOG approval). These actions will help ensure the existence of FTHLs and their habitat in the future.

Determining Whether Compensation Is Required

When compensation is required

If adverse effects remain after the project proponent has taken all reasonable on-site mitigation measures, a project proponent must compensate for the remaining (residual) on-site effects. To evaluate whether it is appropriate to collect compensation, agency biologists must consider whether the impacted area can potentially support FTHLs based on habitat factors favorable to FTHLs (Appendix 6). If agency biologists determine that the project area can potentially support FTHLs, then compensation shall be required. Negative FTHL survey results in the project area shall be irrelevant in the determination of whether to charge compensation because FTHLs can re-occupy the suitable FTHL habitat in the future, or FTHLs were present but not detected due to their cryptic nature.

When compensation is not required

Situations when compensation is not required include the following. First, a project proponent does not need to compensate if the proposed disturbance would not occur in suitable FTHL habitat (e.g., compacted ground, small lots surrounded by urban development, or riparian areas). However, if the project area contains both suitable and unsuitable habitat, agency biologists may base compensation on the entire project area because FTHLs may use unsuitable habitat (e.g., paved or dirt roads or fringes of agricultural fields) adjacent to suitable habitat.

Second, a project proponent does not need to compensate if the agency biologist has determined that mitigation measures have eliminated all adverse, on-site effects (i.e., there are no residual effects).

Third, a project proponent does not need to compensate for disturbances if the signatory authorized the project (e.g., a lease or ROW) before June 1997 (when the signatory signed the conservation agreement), and no longer maintains regulatory discretion to impose compensation. For example, if a signatory granted a ROW to a proponent before June 1997, and the proponent disturbs land within their ROW, the proponent does not need to pay compensation. However, if the signatory renews a permit or ROW authorization, the signatory should require proponents to follow the RMS under the renewed agreement.

Last, signatories to the RMS do not need to compensate for their own disturbances because they are already contributing significant resources towards FTHL conservation. However, if a signatory disturbs over 1% of a FTHL MA (see Planning Action 2.2.1 for details), the signatory must pay compensation based on the compensation formula described below for that exceeded disturbance.

Compensation Determination

Compensation basis

The goal of compensation is to prevent the net loss of FTHL habitat and make the net effect of a project neutral or positive to FTHLs by maintaining a habitat base for FTHLs. To achieve this goal, compensation will be based on the acreage of FTHL habitat lost to a project proponent's impacts on signatory land after all reasonable on-site mitigation has been applied. Compensation for habitat lost outside a FTHL MA will be charged at a 1:1 ratio. When a project proponent's impacts are inside a FTHL MA, a multiplying factor ranging from three to six will be applied to the affected acreage to obtain an adjusted compensation acreage.

This multiplying factor **(M)** for disturbances inside FTHL MAs will be determined by the following formula:

$$M = 3 + A + G + E + D$$

where the factors are evaluated as shown below:

A Adjacent habitat impacts:

a) Adjacent lands will not be affected. 0
b) Adjacent habitat will receive direct or indirect deleterious impacts.....0.5

G Growth inducing effects within flat-tailed horned lizard habitat:

a) The project will have no growth inducing effects. 0
b) The project will have growth inducing effects.....0.5

E Existing disturbance on site:

a) There is moderate to heavy existing habitat disturbance.....0
b) There is little or no existing habitat disturbance. 1

D Duration of effect:

a) The effects of the project are expected to be short term

(< 10 years). 0
b) The effects of the project are expected to be long term
(> 10 years). 1

Signatories should require project proponents to replace the acreage or adjusted acreage lost to the project proponent's impacts. However, signatories may convert either the compensation acreage or adjusted compensation acreage to a monetary equivalent (including administrative costs) that is required to replace the acreage or adjusted acreage. The per acre dollar figure for compensation fees shall be based on the cost of acquiring lands prioritized for acquisition by signatory agencies.

If signatories cannot replace the land disturbed by proponents because lands within FTHL MAs haven't been appraised or there are no more lands available for acquisition (Yuma Desert MA), signatories can charge fair market value of the impacted land and any costs associated with appraising the impacted land. Minimum compensation shall be $200.

Unique Compensation Circumstances

Some land actions have unique circumstances or impacts to FTHLs, and therefore determining the acreage of impact often will depend on the circumstance. Some examples of unique circumstances in common land actions are listed below.

Land disposal

Federal regulation provides for public lands to be made available for disposal via the Recreation and Public Purposes Act. Such land leases and patents are discretionary actions that require both NEPA and Endangered Species Act compliance. Federal land management agencies endeavor to retain ownership of land that provides habitat for sensitive species. However, if a case arises where public lands within FTHL habitat are to be disposed, the signatory disposing the land will collect compensation for the entire acreage regardless if the proponent intends to disturb only a portion of the land because there is no guarantee that the undisturbed portion will remain habitat for FTHLs.

Indirect effects

A project's indirect effects on FTHLs should be considered when determining compensation. For example, ROW grants for aboveground structures such as roads, pipelines, towers, or similar facilities can have adverse impacts to FTHLs beyond the areas that are proposed to be disturbed. First, such disturbances have been shown to attract FTHL predators. For example, roads may attract round-tailed ground squirrels (Garland and Bradley 1984), and towers can provide perching areas for loggerhead shrikes and American kestrels. Second, construction vehicles can introduce invasive weeds that degrade FTHL habitat. Last, vehicles from increased authorized and unauthorized traffic on maintenance roads can cause FTHL mortality. If these and other adverse indirect effects (e.g., habitat fragmentation, decreased FTHL density near roads) cannot be mitigated (with FTHL barriers or corridors, for e.g.), compensation for indirect effects will be required.

Boundaries of MAs

In areas where a MA boundary is defined by a road, the road ROW (not the road itself) will be considered to be the boundary for the MA. Consequently, compensation for residual effects within the ROW will be 1:1.

Recovered FTHL Habitat

Over time, disturbed habitat may recover from a project's residual effects and again become suitable FTHL habitat. If a subsequent project disturbs the recovered area again, the proponent (regardless of whether they were the original proponent) will still be required to pay compensation for residual effects.

Reopening of Mines along the East Highline Canal

For sites that have previously been mined along the East Highline Canal, either inside or outside of the East Mesa MA, compensation shall be charged at a 1:1 ratio if the applicant is not intending to fully mine and complete final reclamation of the site. Compensation shall not be charged if the applicant will be reclaiming the site and no further mining would occur.

Compensation Fund Accounts

Each of the signatories shall maintain an accounting of all compensation funds paid and collected. These accountings shall be incorporated into the annual monitoring report. The BLM shall act as a clearinghouse for all compensation funds and accounting data. Project proponents will pay the BLM through the signatory that authorizes the project. The signatory should give the check to the BLM field office (El Centro or Yuma) that manages the nearest FTHL MA. In addition, the signatory should also provide the secretary of the ICC a completed pre-project and post-project (if appropriate) reporting form for projects/activities that disturb FTHL habitat. The forms are provided in Appendix 8.

Use Of Funds

The agency to receive the compensation land or fee shall be determined through coordination among the permitting agencies. Typically, the compensation fee or land will go to the agency that predominantly manages the nearest MA. Pre-authorized and unauthorized uses are listed below. This list is not exclusive and the MOG, in consultation with the ICC, will ultimately decide how to use compensation funds for unlisted uses.

Pre-authorized uses of funds

Signatories can fund a variety of actions with compensation funds, but funds must directly benefit FTHLs or their habitat within or contiguous with FTHL MAs.

There are several approved uses of compensation funds, but the top priority shall be acquisition of inholdings within the nearest MA (see Planning Action 4). If opportunities for acquisition have been exhausted, examples of activities that could be carried-out with compensation funds include the following:

- Transfer funds to other MAs to purchase FTHL habitat, especially FTHL habitat within or contiguous with MAs that are threatened with imminent impacts.
- Construct and maintain fences and signs around MAs to prevent OHVs from entering and degrading FTHL habitat (see Planning Action 2.4.2). In addition, these fences could be designed to physically prevent FTHLs from leaving the MAs and encountering nearby roads (Appendix 7).
- Educate people and organizations about the effects of OHV use (see Planning Action 7.2). Educators should target those audiences most likely to travel off-road, such as

the public, BP, and utility companies.
- Restore degraded FTHL habitat within or contiguous with MAs (see Planning Action 3).
- Fund other management actions deemed necessary by the ICC and MOG.

Essentially, funds that cannot be used to purchase FTHL habitat within or contiguous with MAs can be used to accelerate implementation of actions identified in the implementation schedule (e.g., expending $100,000 in FY03 for habitat rehabilitation, instead of $40,000 as currently scheduled).

Unauthorized uses of funds

Funds should not be used in place of other agency funding that is obligated or programmed to carryout planning actions listed in the implementation schedule. For example, signatories shall not fund law enforcement and FTHL research/monitoring with compensation funds because signatories to this document have agreed to implement monitoring and law enforcement activities with their own funds.

Monitoring Program

In accordance with the first objective of this RMS (to "maintain a 'long-term stable' or increasing population of FTHLs in all MAs"), a population monitoring program has been implemented to learn how FTHL populations are changing over time. Determining whether there is a trend means obtaining accurate measurements of the populations over time, then removing "the effects of natural demographic and environmental stochasticity." Such effects are currently unknown; hence the monitoring also has a goal to document the variability in FTHL populations in response to natural processes (such as drought cycles).

Monitoring cannot reveal the actual causes of a population trend (Elzinga *et al.* 1998). However, by monitoring habitat disturbance in addition to population and distribution, correlations can be made between population change and one potential cause for decline. Even without conclusive proof of its cause, if a population or distribution decline of >30% is noted within any MA, and factors other than climate are the potential cause, the ICC will draft management prescriptions to reverse the trend. If declines are correlated with increased habitat disturbance from OHV use (documented either through ground surveys or aerial monitoring), signatory agencies will take measures to limit OHV traffic. If statistical proof of causal relationships is deemed necessary, the costs of implementing a research program with replicated controls and treatments will be evaluated.

The foundation for an inventory and monitoring program was laid in 1978 with surveys conducted on East Mesa, West Mesa, and Yuha Basin (Turner *et al.* 1978). Some monitoring has been conducted every year since then except 1980, 1982, and 1983. Distribution and relative abundance of FTHLs were estimated through much of the range of the species in California and Arizona by use of standardized 3-mile triangular transects in which numbers of FTHLs and their scat were counted and used as an index to relative abundance (Turner and Medica 1982; Rorabaugh *et al*. 1987; Olech undated; BLM and CDFG 1990; Wright 1993). Scat transect methods were standardized in 1990 (BLM and CDFG 1990). Trends on BLM-administered lands have been analyzed periodically (Olech 1986; Wright 1993, 2002). In addition to BLM-administered lands,

inventories of the Navy target areas (Dames & Moore 1995; Rorabaugh 1996b), Salton Sea Naval Base (Muth and Fisher 1989; Rorabaugh 1996c) and OWSVRA (Wone *et al*. 1994; Wone *et al.* 1995; Wone and Beauchamp 1995a, 1995b) have been conducted.

Two critical assumptions of the scat transect survey method are 1) FTHL scat is readily distinguishable from other lizard's scat, and 2) scat and lizard counts are correlated with FTHL density.

The first assumption is largely met by not counting scat less than 5.5 mm in diameter (Muth and Fisher 1992) and not using scat counts to estimate relative density in areas where desert horned lizards occur (desert horned lizard scat is indistinguishable from FTHL scat) (Turner and Medica 1982).

The second assumption has been problematic. The relationship between scat counts and horned lizard density has been difficult to examine due to the problems associated with obtaining true FTHL density estimates. But several reports suggest that if scat is correlated with lizard density, the relationship may be weak (Muth and Fisher 1992; Rorabaugh 1994; Beauchamp *et al.* 1998). Wright (1993) found a correlation between FTHL counts and scat; however, the relationship between lizard counts and relative abundance is unknown. Use of lizard count data to estimate relative density is suspect due to the infrequency with which FTHLs are observed on triangular scat transects (on average less than one animal per 10 hours of searching) (Turner and Medica 1982; Rorabaugh *et al*. 1987) and because environmental conditions are likely to influence FTHL activity and detectability. Scat counts in the same area may fluctuate greatly from year to year (Wright 1993; Rorabaugh 1994), but there are factors other than lizard density that affect numbers of scat that are produced and visible (Muth and Fisher 1992; Rorabaugh 1994; Young 2002). Beauchamp *et al.* (1998) note that the presence of several scat in an area suggests two indistinguishable alternatives: either a single individual used the area repeatedly and the scat persisted, or multiple individuals have used the area over a shorter time span.

Due to the animal's cryptic nature, monitoring efforts typically yield highly variable, low encounter rates, making analysis of monitoring data problematic. In a recent analysis of 1979-2001 FTHL monitoring data, no population trends were detected despite increases in habitat disturbance (Wright 2002). It was noted that inconsistencies between observers and changes in monitoring protocols added to the difficulties of detecting trends. Because of known problems with scat surveys and lizards encountered on line transects, new monitoring methods were called for (Foreman 1997).

Two new monitoring techniques are being implemented as part of this first revision. Implementation of these revised monitoring methods should increase sensitivity to detecting future trends. The first is an improved mark/recapture population monitoring technique developed by Wright and Grant (2002) (see Appendix 4). Using this technique, they estimated a population of about 30,000 FTHLs (95% CI: 21,500 – 33,000) in the Yuha Desert MA during the summer of 2002, with an average density of 1.3 lizards per hectare (0.5 per acre). Percent sand coverage was the only variable significantly correlated with population size. This technique has yielded the best wide-scale population estimate to date.

Pronounced natural fluctuations and potentially large confidence intervals may still mask detection of long-term population trends. Additionally, the small number of mark/recapture plots may be insufficient for detecting localized population declines, such as on the edges of MAs. In

addressing these problems, the ICC felt that monitoring changes in FTHL distribution and changes in habitat disturbance could supplement monitoring population trends, to provide a more sensitive indicator of unnatural population declines. Distribution may be monitored by gathering presence/absence data (Appendix 5). These data, in conjunction with GIS overlays, can be used to create a predictive spatial model using StatMod (Garrard 2002), which will aid in detecting declines in distribution and may serve to tighten the population estimates obtained from the mark/recapture surveys.

The protocols for monitoring population and distribution both include measuring disturbance at the sample sites. In addition to those measures, wide-scale (aerial) monitoring of surface disturbance will occur every five years (see Planning Action 9.2.3.1).

It is anticipated that a population estimate from mark/recapture will be obtained from each MA during the next five years, which will allow for evaluation of this technique as a long-term monitoring tool. The distribution monitoring protocol is yet untested. It is recommended that it be implemented on a trial basis (e.g. in one MA for two years) and evaluated by the ICC to determine whether to expand the sampling. Following these new protocols over the next five years will establish baseline estimates against which future comparisons can be made. It is anticipated that during the 2007 revision of this document, the baseline data will be carefully reviewed and the ICC will determine whether or not they can set population and distribution thresholds which, if reached, would act as a stimulus for more drastic management efforts.

Restorative Measures

The following restorative measures are prescribed in the Planning Actions and are explained in more detail in this section. A discussion of how these measures were implemented can be found in the Summary of Management Strategy Implementation, 1997-2002, under actions 2, 3, and 5.

Route Closures

To reduce direct mortality from vehicles and to limit the increase in surface disturbance from the proliferation of routes, each discretionary, designated route in a MA shall require justification for the necessity of the route. Designated routes shall be prioritized in terms of importance to FTHLs and to the OHV community and other public and private route users. Redundant, low priority, and non-essential routes in MAs shall be closed and restored.

The following process will be utilized to reduce route density in MAs:

Step 1 - A small, interdisciplinary team shall be formed. The team should include, at a minimum, biological and recreation staff from the land management agency and representatives of USFWS, the state wildlife agency, the state OHV recreation agency, and important user groups. Other management agency staff, such as surface protection specialist or realty specialist, may be added as desirable.

Step 2 - The team shall identify non-discretionary routes (e.g., routes with existing ROWs) and discretionary routes (i.e., routes that can be closed at the discretion of the land management agency).

Step 3 - Representatives of users of routes shall assign an importance priority to each discretionary route. A written justification for each desired open route shall be prepared.

The team shall evaluate route densities and priorities, FTHL population density and trend data, FTHL home range size, and habitat disturbance attributed to routes to determine the level of route closures needed to ensure viable populations of FTHLs. Areas within MAs that support high levels of vehicular use and that are particularly important for the FTHL shall be identified as high priority areas for route closure.

Step 4 - Within areas identified for route closure, the team shall identify discretionary routes needing closure. Any discretionary route that serves no identifiable purpose, parallel routes, routes with no identifiable destination, and routes with high resource damage shall also be recommended for closure. Routes along utility corridors and canals and routes used by agencies (e.g., BP access) shall be evaluated for closure except to specific, authorized users.

Step 5 - All necessary federal and state environmental reviews shall be completed.

Step 6 - Closed routes shall be signed, as necessary, and restored.

Habitat Rehabilitation

Damaged and degraded areas in the desert may take centuries to recover their original appearance and ecosystem function without intervention. Preparation of the ground surface and replanting of vegetation may speed the restoration of the native flora, the rebuilding of the soil structure, and the reestablishment of native wildlife. Available techniques are reviewed in Lovich (1993).

Lovich and Bainbridge (1999) estimate low-intensive restoration efforts can cost $30,000 to $62,000 per acre. Besides being expensive, plants often die after re-vegetation efforts because of unknown, unpredictable, or uncontrollable environmental factors (e.g., drought or unsuitable soil conditions). Given the cost, recovery time, and the low to moderate probability of long-term success of restoration efforts, it is more effective to limit the extent and intensity of the initial impacts to the land (Lovich and Bainbridge 1999). Nonetheless, there are times when habitat rehabilitation is worthwhile. When a decision has been reached to restore a degraded area within an MA, and the underlying causes of habitat degradation have been removed (such as closing routes of travel), the most effective rehabilitation techniques known must be used. Since little is known about the habitat factors that benefit FTHL, initial rehabilitation efforts should be planned in an experimental fashion and the results of various treatments should be well documented so they can be improved upon over time.

Corridors

It is recognized that the Colorado River has been a long-term, natural barrier between populations in Arizona and California, and that this may have resulted in genetic divergence (see Figure 2). During the past century, the populations in East Mesa were effectively isolated from those to the west and south by the Salton Sea, extensive agricultural development, canals, and highways. However, managed areas to the west (i.e., Yuha Desert, West Mesa, Ocotillo Wells, and Borrego Badlands) lie relatively close to one another, and some movement between MAs may occur. Populations in the Coachella Valley are probably currently disjunct from those in the Imperial and

Borrego valleys. Planned actions provide guidance for managers to maintain sufficient habitat to provide for interchange of FTHLs between MAs, where habitat corridors persist. In this way, those naturally adjoining populations of FTHLs will be able to interbreed, helping to maintain genetic vigor, and natural recolonization could occur in the case of extirpation from local populations.

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APPENDICES

Appendix 1. 1997 Conservation Agreement

CONSERVATION AGREEMENT
PHRYNOSOMA MCALLII, FLAT-TAILED HORNED LIZARD

1. PURPOSE AND NEED

The flat-tailed horned lizard is a small, phrynosomatid lizard inhabiting sandy flats and valleys from the Coachella Valley, California, south and east through the Borrego and Imperial valleys, California, Southwestern Yuma County, Arizona, and adjacent portions of Baja California Norte and Sonora, Mexico. Approximately 34 percent of flat-tailed horned lizard habitat has been converted to urban or agricultural uses, or was inundated by the Salton Sea early in this century and is no longer occupied by the species. Six key habitat areas remain in the United States, including the Ocotillo Wells area, Borrego Badlands, West Mesa, Yuha Desert, and East Mesa in California, and the Yuma Desert in Arizona. These areas are subject to a variety of activities that degrade habitat, including agricultural, residential, and industrial development, off-highway vehicle use, geothermal development, sand and gravel operations, military activities, fire, and construction of roads, canals, and utilities. Although population trends are difficult to monitor, evidence suggests populations may have declined in two key areas, including northern East Mesa and the Yuha Desert. The Fish and Wildlife Service proposed the flat-tailed horned lizard as a threatened species in a November 29, 1993 Federal Register Notice. Collection of the species is prohibited by state law in Arizona and California. Further information on the status, distribution, taxonomy, and threats facing this species can be found in the Rangewide Management Strategy (Appendix 1), which serves as a Conservation Assessment and Conservation Strategy.

Occupied habitat is under the jurisdiction of a variety of federal, state, local government, and private entities. The primary land owners or managers of flat-tailed horned lizard habitat in California include; the Bureau of Land Management, Department of the Navy, California Department of Parks and Recreation (Ocotillo Wells State Recreational Vehicle Area and Anza Borrego Desert State Park), Bureau of Reclamation, and private individuals. In Arizona, the primary land owners or managers are; Marine Corps Air Station Yuma, Bureau of Reclamation, Bureau of Land Management, Arizona State Land Department, and private individuals. In both states, the U.S. Border Patrol is empowered with broad law enforcement authority and conducts many activities in flat-tailed horned lizard habitat, particularly within 25 miles of the international boundary. Local governments, including cities and counties, affect location and types of development, and may affect rates of growth within their jurisdiction. The six key habitat areas are managed primarily by the parties to this agreement.

This Conservation Agreement has been initiated to conserve the flat-tailed horned lizard by reducing threats to the species, stabilizing the species' populations, and maintaining its ecosystem. The document's primary purpose is to conserve the flat-tailed horned lizard through conservation measures under the Endangered Species Act of 1973, as amended.

The Conservation Agreement establishes a general framework for cooperation and participation among signatories. The signatories will provide support to the program as needed, and will provide input on current and future program needs. The Agreement is made and entered into to meet the following objective: 1) Implement the Flat-tailed Horned Lizard Rangewide Management Strategy (Appendix 1), thus establishing an open process by which to identify and carry out such actions as will conserve the species through voluntary participation of public and private partners.

II. INVOLVED PARTIES

In order to meet the present and/or future needs of this conservation effort, this Agreement may be modified or amended at any time by mutual written concurrence of the cooperating agencies to facilitate additional cooperators. The parties below are currently involved in this agreement.

Ecological Services - Carlsbad Field Office
U.S. Fish and Wildlife Service
2730 Loker Avenue West
Carlsbad, California 92008

Ecological Services Phoenix Field Office
U.S. Fish and Wildlife Service
2321 West Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951

U.S. Bureau of Land Management
California Desert District
6221 Box Springs Boulevard
Riverside, California 92507

U. S. Bureau of Land Management
Yuma District
2555 Gila Ridge Road
Yuma, Arizona 85365

U.S. Bureau of Reclamation
Yuma Area Office
P.O. Box D
Yuma, Arizona 85356

Marine Corps Air Station - Yuma
Box 99220
Yuma, Arizona 85369-9220

U.S. Navy
El Centro Naval Air Facility
El Centro, California 92243-5001

Arizona Game and Fish Department
2221 West Greenway Road
Phoenix, Arizona 85023-4399

California Department of Fish and Game
330 Golden Shore, Suite 50
Long Beach, California 90802

California Department of Parks and Recreation
Off-Highway Motor Vehicle Division
Ocotillo Wells State Recreational Vehicle Area
P.O. Box 320
Borrego Springs, California 92004

California Department of Parks and Recreation
Anza Borrego Desert State Park
P.O. Box 299
Borrego Springs, California 92004

III. AUTHORITIES

The authorities for the involved parties to participate in this Conservation Agreement are derived from the following legislation:

U.S. FISH AND WILDLIFE SERVICE:

Endangered Species Act of 1973, as amended
Fish and Wildlife Act of 1956, as amended
Fish and Wildlife Coordination Act of 1934, as amended
Sikes Act of 1960, as amended

U.S. BUREAU OF LAND MANAGEMENT

Endangered Species Act of 1973, as amended
Federal Land Policy Management Act
Sikes Act of 1960, as amended

U.S. BUREAU OF RECLAMATION

Endangered Species Act of 1973, as amended
Fish and Wildlife Coordination Act of 1934, as amended

MARINE CORPS AIR STATION - YUMA

Endangered Species Act of 1973, as amended
Sikes Act of 1960, as amended

U. S. NAVY EL CENTRO NAVAL AIR FACILITY

Endangered Species Act of 1973, as amended
Sikes Act of 1960, as amended

ARIZONA GAME AND FISH DEPARTMENT

Arizona Revised Statute 17-231.B-7
Endangered Species Act of 1973, as amended
Sikes Act of 1960, as amended

CALIFORNIA DEPARTMENT OF FISH AND GAME

Endangered Species Act of 1973, as amended
Sikes Act of 1960, as amended
California Fish and Game Code section 1802
California Fish and Game sections 3450 et seq.

CALIFORNIA DEPARTMENT OF PARKS AND RECREATION

Endangered Species Act of 1973, as amended

In addition to the above-listed legislative authorities, the following interagency agreements provide a framework for cooperation and participation among involved parties in the conservation of species tending towards listing: a Memorandum of Understanding signed by the U.S. Fish and Wildlife Service, the U.S. Bureau of Land Management, the U.S. Forest Service, the National Park Service, the National Marine Fisheries Service, and the International Association of Fish and Wildlife Agencies, issued on January 25, 1994 and amended on March 20, 1994 (Appendix 2); and a Memorandum of Understanding signed by 14 federal agencies, including among others, the U.S. Fish and Wildlife Service, the U.S. Bureau of Land Management, U.S. Bureau of Reclamation, and Department of Defense on September 28, 1994 (Appendix 3).

IV. IMPLEMENTATION OF CONSERVATION ACTIONS

Conservation actions necessary to ensure the long-term persistence of the flat-tailed horned lizard are identified in the Flat-tailed Horned Lizard Management Plan implementation schedule. Subject to availability of funds and compliance with all applicable regulations, the involved parties agree to implement actions according to scheduled completion dates and by responsible parties, as shown in the implementation schedule. If threats have been removed to a degree that the flat-tailed horned lizard does not meet the definition of a threatened species, pursuant to the Act, the Fish and Wildlife Service may withdraw the proposed rule to list the flat-tailed horned lizard as threatened. If the species is withdrawn and it becomes known that there are threats to the survival of the species that are not or cannot be resolved through this or any Conservation Agreement, the species will be re-assigned to candidate status and an appropriate listing priority assigned.

NOW THEREFORE, in consideration of the above premises, the cooperators enter into this Agreement as full and equal partners to accomplish its purpose and objectives.

All cooperators agree to:

1 . Further develop and implement the objectives, strategies, and tasks of the Flat-tailed Horned Lizard Rangewide Management Strategy

2. As needed for this conservation effort, and as available, provide program personnel with facilities, equipment, logistical support, and access to lands under their control.

3. Participate regularly in ICC and MOG meetings to enhance communication and cooperation, and to help develop annual or other work plans and reports.

4. Develop and distribute public information and educational materials on this conservation effort.

5. Provide ongoing review of, and feedback on, this conservation effort.

6. Cooperate in development of major media releases and media projects.

7. Keep local governments, communities, the conservation community, citizens, and other interested and affected parties informed on the status of this conservation effort, and solicit their input on issues and actions of concern or interest to them.

8. Whenever possible, develop voluntary opportunities and incentives for local communities and private landowners to participate in this conservation effort.

9. Assist in generating the funds necessary to implement this conservation effort.

V. FLAT-TAILED HORNED LIZARD INTERAGENCY COORDINATING COMMITTEE

1. The involved parties shall designate a representative to serve on the Flat-tailed Horned Lizard Interagency Coordinating Committee (ICC). The ICC shall monitor the implementation of the Rangewide Management Strategy and provide a forum for exchange of information on the species. The ICC shall also be responsible for specific tasks as set forth in the implementation schedule. Through mutual agreement among designated representatives of all involved parties, the ICC may recommend changes in the tasks and scheduling of task implementation to the MOG, as described in the implementation schedule of the

Rangewide Management Strategy. The ICC shall in no way make recommendations to or serve as an advisory group to a federal agency.

Designated representatives shall attend at least two meetings of the ICC annually for the life of this Agreement to review progress and coordinate work priorities and schedules.

VI. FLAT-TAILED HORNED LIZARD MANAGEMENT OVERSIGHT GROUP

The involved parties shall designate a management-level representative to serve on the Flat-tailed Horned Lizard Management Oversight Group (FTHL MOG). The FTHL MOG will perform management-level duties, as described in the Rangewide Management Strategy and as identified by the ICC. The FTHL MOG shall meet semi-annually, or as needed. Members of the FTHL MOG have been selected by each signatory agency, and are listed below.

Bureau of Land Management, California	El Centro Resource Area Manager
Bureau of Land Management, Arizona	Yuma Field Office Manager
Bureau of Reclamation, Yuma	Yuma Area Manager
U.S. Fish and Wildlife Service, Region 1	Assistant Field Supervisor, Carlsbad
U.S. Fish and Wildlife Service, Region 2	Field Supervisor, Phoenix
Arizona Game and Fish Department	Yuma Region Supervisor
California Department of Parks and Recreation	Ocotillo Wells SVRA Superintendent
Anza Borrego Desert State Park	Superintendent
El Centro Naval Air Station	Resource Management Officer
Barry Goldwater Range	Range Management Officer
California Department of Fish and Game	Regional Manager

VII. ADMINISTRATIVE CLAUSES

1. Nothing herein shall be construed as obligating the parties to expend or as involving the parties in any contract or other obligation for the payment of money in excess of appropriations authorized by law and administratively allocated to work described herein.

2. This agreement is not a fund obligating document, and each party shall carry out its separate activities in a coordinated and mutually beneficial manner. Any activity that may create an exchange of funds will be conducted outside the scope of this agreement as authorized by law or regulations of each party.

3. All parties are hereby put on notice that the Arizona Game and Fish Department's participation in this agreement is subject to cancellation by the Governor of Arizona pursuant to A.R.S. 38-511 if any person is significantly involved in initiating, negotiating, securing, drafting, or creating a contract on behalf of the state of Arizona or any of its departments or agencies at any time while the contract or any extension of the contract is in effect, or is an employee of any other party to the contract in any capacity or a consultant to any other part of the contract with respect to the subject matter of the contract.

4. This Agreement will not be effective with respect to the Arizona Game and Fish Department until the fully executed Agreement is filed with the Arizona Secretary of State.

5. Pursuant to the laws of Arizona (A.R.S. 35-124 and 35-215, and section 41-1179.04, as amended), California, and the United States, all jointly maintained books, accounts, reports, files, and other records relating to this Agreement shall be subject at all reasonable times to inspection and audit by the state of Arizona, the state of California, and the federal government for five

years after completion of the Agreement. Such records shall be reproduced as designated by the state of Arizona, the state of California, and the federal government.

6. Any contracts entered into as a result of this Agreement shall comply with all state and federal contracting laws, including all applicable laws prohibiting discriminatory employment practices by contractors. Contracts entered into by the state of Arizona shall incorporate the Arizona Governor's Executive Order No. 75-5 entitled "Prohibition of Discrimination in State Contracts - Non-discrimination in Employment by Government Contractors and Subcontractors".

7. To the extent required or permitted by the laws of Arizona (Arizona Revised Statutes section 12-1518 and any successor statutes), California, and the United States, the cooperators agree to use arbitration, after exhausting all applicable administrative remedies, to resolve any dispute arising out of this agreement, where not in conflict with federal law or laws of the state of California. Any arbitration with respect to real property shall occur in the state where the real property is located or, if the real property is owned by the United States, shall be conducted pursuant to federal law.

IT IS MUTUALLY AGREED AND UNDERSTOOD BY AND BETWEEN THE COOPERATORS THAT:

1. Specific work projects or activities that involve transfer of funds services, or property among cooperators to this Agreement may require execution of separate agreements or contracts.

2. Specific proposed project actions or changes in management activities may require amendments to existing land use plans and further environmental analysis before implementation.

3. Conflicts between or among cooperators concerning procedures or actions under this Agreement that cannot be resolved at the operational level (i.e. by cooperator representatives to the MOG or ICC) will be referred to the next higher level within each cooperator, as necessary, for resolution.

VIII. DURATION OF AGREEMENT

The term of this Agreement shall begin on the date the Agreement is filed with the Secretary of State, after signed by all parties, and end after all tasks identified in the implementation schedule are completed, or until terminated by mutual concurrence of all the parties. The involved parties shall review the Conservation Agreement and its effectiveness annually to determine whether it should be revised. Within a year of completing the tasks identified in the implementation schedule, the Conservation Agreement shall be reviewed by the involved parties and either modified, renewed, or terminated. This Agreement may, at any time, be amended, extended, modified, supplemented, or terminated by mutual concurrence. Any party may withdraw from this Agreement by providing 60 days notice to the other parties in writing.

IX. SIGNATURES

[The original, signed signature pages are not included]

IN WITNESS WHEREOF:

The cooperators hereto have executed this Agreement as of the last written date below.

For the **U.S. DEPARTMENT OF INTERIOR, FISH AND WILDLIFE SERVICE, REGION 1**
Michael Spear, Regional Director

For the **U.S. DEPARTMENT OF INTERIOR, FISH AND WILDLIFE SERVICE, REGION 2**
Nancy Kaufman, Regional Director

For the **U.S. DEPARTMENT OF INTERIOR, BUREAU OF LAND MANAGEMENT, CALIFORNIA STATE OFFICE**
Edward Hastey, State Director

For the **U.S. DEPARTMENT OF INTERIOR, BUREAU OF LAND MANAGEMENT, ARIZONA STATE OFFICE**
Denise Meridith, State Director

For the **U.S. DEPARTMENT OF INTERIOR, BUREAU OF RECLAMATION, LOWER COLORADO REGION**
Robert Johnson, Regional Director

For the **U.S. DEPARTMENT OF DEFENSE, MARINE CORPS AIR STATION - YUMA**
C. J. Turner, Commanding Officer

For the **U.S. DEPARTMENT OF DEFENSE, EL CENTRO NAVAL AIR FACILITY**
Captain P. T. Madison, Commanding Officer

For the **ARIZONA GAME AND FISH DEPARTMENT**
Duane Shroufe, Director

For the **CALIFORNIA DEPARTMENT OF FISH AND GAME**
Jacqueline E. Schafer, Director

For the **CALIFORNIA DEPARTMENT OF PARKS AND RECREATION**
Donald Murphy, Director

Appendix 2. Federal Plans Affecting Flat-tailed Horned Lizard Habitat

Bureau of Land Management lands

In 1980, the Secretary of the Interior signed the California Desert Conservation Area Plan (BLM 1980) prescribing land uses on BLM-administered lands in California. The existing network of designated routes is illustrated on BLM's Desert Access Guides (maps). The Desert Plan established two ACECs to conserve the FTHL - the Yuha Basin (40,622 acres) and East Mesa ACECs (40,712 acres). The Desert Plan also directed that habitat management plans be written for lands adjacent to these ACECs. Although not designated specifically for the FTHL, the San Sebastian Marsh/San Felipe Creek ACEC (6,337 acres) and Dos Palmas ACEC (14,400 acres) also contain habitat for the FTHL.

In 1990, the BLM and CDFG signed the "Management Strategy for the Flat-tailed Horned Lizard on Bureau of Land Management Administered Lands within the California Desert Conservation Area" (BLM and CDFG 1990). Habitat categories were defined, and a category map was developed in the plan. A policy and formula were instituted for projects to compensate for lost or degraded habitat. Other management activities to reduce habitat degradation and loss were implemented. Measures implemented through various plans were brought into a species rangewide (California only) context. Among these were the research program, the inventory and monitoring program, interagency coordination, and habitat compensation.

California

Yuha Basin ACEC

In 1981, a combined plan was prepared for the Yuha Basin ACEC (BLM 1981). Specific actions in the plan were designed to protect sensitive cultural and wildlife resources while allowing for mineral material sales, geothermal development, and motorized vehicle competitive events. In 1983, a habitat management plan was prepared for the adjacent Yuha Desert area (BLM 1983). Measures were similar to the Yuha Basin ACEC Plan with additional measures dealing with monitoring of FTHL population trends, exchanges and acquisitions, and formation of an interagency coordinating committee. In response to indications of declining FTHL populations and increasing damage to cultural resources due to route proliferation and cross-country vehicle travel in Yuha Basin, the "Yuha Desert Management Plan" (BLM 1985) was prepared. This plan covers both of the previous areas plus several adjacent ACECs and Natural Areas. The plan tightened controls on, but did not eliminate OHV competitive events. Routes of travel were reduced in number. Camping was restricted to a 25-foot corridor along routes of travel. Law enforcement was increased. Other actions dealing with interagency coordination and monitoring of population trends were strengthened. In 1985, the Yuha Basin ACEC was expanded to 63,000 acres.

East Mesa ACEC

In 1982, the "Southern East Mesa ACEC Management Plan" (BLM 1982a) and "East Mesa Wildlife Habitat Management Plan" (BLM 1982b) were completed. The two plans covered adjacent areas and included similar measures. Although not previously conducted in East Mesa, competitive events were formally prohibited, but oil and gas leasing and geothermal energy development were allowed. The ACEC is closed to mineral material sales. Inventory and monitoring of FTHL populations were given a high priority.

San Sebastian Marsh/San Felipe Creek ACEC

In 1986, the "San Sebastian Marsh/San Felipe Creek [ACEC] Management Plan" (BLM 1986a) was signed. Based on scat counts, FTHLs are locally abundant in this ACEC (BLM 1986a). Most measures in the plan were aimed at protecting and enhancing the aquatic and riparian resources. The ACEC is closed to vehicle entry. The ACEC encompasses about 5,100 acres administered by the BLM and about 1,250 acres administered by the CDFG.

Dos Palmas ACEC

Limited FTHL habitat is found in the Dos Palmas ACEC along the northeastern side of the Salton Sea. This area encompasses about 14,400 acres of federal, state, and private lands. Dos Palmas ACEC originated in 1980 as the Salt Creek ACEC, at the time about 2,500 acres to protect Yuma clapper rail, desert pupfish, and other sensitive biological resources, including the FTHL. In 1998, BLM prepared an Ecosystem Management Plan for the ACEC and continues to implement that today.

West Mesa

The West Mesa ACEC was officially designated in 1986 to protect habitat of the FTHL, rare plants, and cultural resources. No plan has been written at this time. The ACEC encompasses more than 20,300 acres, including about 1,600 acres of private land.

Algodones Dunes

A habitat management plan for the Algodones Dunes was prepared in 1987 (BLM 1987b). Based on scat counts, FTHLs are present in small numbers, mostly around the periphery of the dunes. The plan focuses on general enhancement and protection of the flora and fauna of the dunes. Most of the dunes north of Highway 78 is designated wilderness; the dune area south of Highway 78 is open to vehicular cross-country travel.

Arizona

BLM Yuma Field Office manages approximately 900 acres of potential FTHL habitat. These 19 land parcels range in area from 1.6 to 335 acres with an average area of 46 acres. Most of the potential FTHL habitat is poor quality because parcels are typically small, fragmented, and disturbed.

BLM manages lands within the Yuma Field Office under the Yuma District Resource Management Plan (BLM 1987a) and the Lower Gila South Resource Management Plan (BLM 1998). In addition, amendments have been developed for the Yuma Resource Management Plan. They are the: Lower Gila South Resource Management Plan – Goldwater Amendment (BLM 1990), Yuma District Resource Management Plan Amendment (BLM 1992), Yuma District (Bill Williams) Resource Management Plan Amendment (BLM 1994), Yuma District (Havasu) Resource Management Plan Amendment (BLM 1994), Yuma District (Lands) Resource Management Plan Amendment, and Lechuguilla-Mohawk Habitat Management Plan (BLM 1997).

Currently, the FTHL RMS is addressed in the Lechuguilla-Mohawk Habitat Management Plan, and BLM-Yuma has been following the RMS since its inception. BLM-Yuma plans to incorporate the RMS in its upcoming resource management plan.

Department of Defense Lands

California

The Congress has withdrawn two military ranges in California, R-2510 (West Mesa) and R-2512 (East Mesa). The ranges have been withdrawn from all forms of appropriation under public land laws and are reserved for use by the Secretary of the Navy for defense-related purposes. This withdrawal became effective on October 1, 1996, and is in effect for 25 years. FTHLs occur throughout both of these ranges. Although the ranges are withdrawn from entry for non-military uses, R-2510 is adjacent to an OHV open area, and trespass OHV activity occurs. R-2512 also has some OHV use but to a lesser extent. Land management strategies and responsibilities will be developed through a new memorandum of understanding between BLM and the Department of the Navy.

Arizona

The passage of the Military Lands Withdrawal Act of 1986 (Public law 99-606) transferred land management responsibilities on the BMGR to the BLM. However in 2001, land management responsibilities transferred back to the DOD under the Military Lands Withdrawal Act of 1999 (Public law 106-65). DOD will manage the BMGR under the Integrated Natural Resources Management Plan, which is in preparation as of this writing.

On the BMGR, FTHL habitat occurs in portions of three special areas: 1) the Gran Desierto Dunes ACEC; 2) the Yuma Desert and Sand Dunes Habitat Management Area; and 3) the extreme western portion of the Tinajas Altas Mountains ACEC. In these areas, OHV use, camping, new ROWs, and other land use authorizations are limited. For safety reasons, MCAS-Yuma issues range passes for visitors to the BMGR. Visitors are restricted to driving street-legal vehicles, which further inhibits off-road travel.

For military activities on the BMGR, the USFWS has prepared a conference opinion (USFWS 1996a) that provides guidance for activities affecting the FTHL.

Bureau of Reclamation lands

About 600,000 acres, mostly in Imperial County, California, were withdrawn by Secretarial orders dating back to the early 1900's for use by the BOR in development of the All-American Canal, Boulder Canyon, Colorado River Storage, and Yuma Reclamation projects. Lands were withdrawn from settlement, sales, location under the mining laws, and entry. Withdrawn lands are managed by the BLM under an agreement with the BOR signed in 1978. The Federal Land Policy and Management Act of 1976 directed agencies holding withdrawals to work with the BLM to determine which withdrawals were obsolete and should be terminated; agency recommendations were to be submitted to the Department of the Interior for review and approval. In January 1992, recommendations reflecting the coordinated efforts of the BOR, BLM, and the Imperial and Coachella Valley Irrigation Districts were submitted to the Department of the Interior. It was recommended that 133,712 acres continue under withdrawal and that withdrawals be terminated on 444,781. The California Desert Conservation Area Plan (BLM 1980) will cover lands released from withdrawal. Unless within the boundaries of the 1964 Lower Colorado River Land Use Plan, lands continuing under withdrawal and covered under the earlier agreements will be managed by BOR.

Appendix 3. Legal Description of Management and Research Areas

Description of Yuma Desert Flat-tailed Horned Lizard Management Area

Beginning in the northwest corner of the area, the northern boundary of the MA is approximately 50 feet south of the BMGR boundary to accommodate County 14th Street and its right-of-way. On the eastern side of the MA, the boundary follows Foothills Boulevard south to the Auxiliary 2 service road. East and south along the Auxiliary 2 road to its end in Sec. 23 in T.11S., R.21W. The boundary then follows a southeasterly direction to the International Boundary. The southern boundary of the MA follows the International Boundary to Avenue D. The boundary includes federally administered lands in the Five-Mile Zone east of Avenue D and south of County 23rd Street, excluding the State Prison and the Yuma City Landfill. Along County 23rd Street and the western side of the BMGR, the boundary follows the proposed Area Service Highway route, excluding the proposed highway and its ROW.

In the interim period until a full analysis of alternative corridors is completed, federally administered lands within the BMGR west of the proposed route of the Area Service Highway and in the Five-Mile Zone north of the proposed route will be managed in accordance with prescriptions that apply to MAS.

QUAD SHEETS:

East boundary – Butler Mountains, Vopoki Ridge SE, Vopoki Ridge, W. of Vopoki Ridge, Fortuna SW, Fortuna

North boundary – Fortuna, Yuma East

West boundary – Yuma East, Yuma SE, S.E. of Somerton, S. of Somerton

South boundary – S. of Somerton, S.E. of Somerton, W. of Vopoki Ridge, Vopoki Ridge SW, Vopoki Ridge SE, Butler Mountains

Description of East Mesa Flat-tailed Horned Lizard Management Area

All are San Bernardino Meridian.

[East boundary] Beginning in Sec. 31 in T.16S., R.20E. at the intersection of Frontage Road and West Levee Road on the north side of the All-American Canal, then northwest along the West Levee Road (on west levee of Coachella Canal) to Highway 78 (Glamis Highway) in Sec. 35 in T.13S., R.17E;

[North boundary] then west on Highway 78 to the intersection with an unnamed dirt road in NW¼NE¼NE¼ Sec. 2 in T.14S., R.16E.;

[West boundary] then south on this dirt road to the intersection with BLM Route A181 in Sec. 23 in T.14S., R.16E., then south on BLM Route A181 to BLM Route A3410 in Sec. 11 in T.15S., R.16E., then eastward and southward on BLM Route A3410 to BLM Route A357 in Sec. 18 in T.15S., R.17E, then east on BLM Route A357 for about 0.3 miles to the west side of Sec. 17 in T.15S., R.17E., then south on the west side of Sec. 17, 20, 29, 32 in T.15S., R.17E. and Sec. 5, 8, and 17 in T.16S., R.17E to the Frontage Road on the north side of Interstate Highway 8 in Sec. 17 in T.16S., R.17E.;

[South boundary] then east on Interstate 8 Frontage Road to the west side of E½E½ Sec. 31 in T.16S., R.19E., then due north to the northern side of Sec. 31, then east 1.0 miles to the west side of E½E½ Sec. 32 in T.16S., R.19E., then due south to the Frontage Road, then east to the west side of Sec. 36 in T.16S., R.19E., then north to the N½ Sec. 36, then due east 1 mile to the east side of Sec. 36, then south to Frontage Road, then east on Frontage Road to the West Levee Road.

QUAD SHEETS:

East boundary - Grays Well, Cactus, Glamis SE, Glamis SW, Glamis NW.

North boundary - Glamis NW, Holtville NE.

West boundary - Holtville NE, Holtville East, Glamis SW.

South boundary - Glamis SW, Midway Well NW, Midway Well, Grays Well.

Description of West Mesa Flat-tailed Horned Lizard Management Area

All are San Bernardino Meridian.

[East boundary] Beginning in southeast corner of Sec. 30 in T.14S., R.13E. and north along the east side of Sec. 30, 19, 18, and 7 to the south side of N½ of Sec. 7, then west and north around SW¼NE¼ Sec. 7, then west and north around NW¼NE¼ Sec. 7, then west along the north side of N½ Sec. 7, then north about 0.15 miles along the east side of Sec. 13 in T.14S., R.12E. to the southeast corner of Sec. 12, then in Sec. 12, west and north around E½SE¼, then west and north and east around SW¼NE¼, then north along the west side of NE¼NE¼, then in Sec. 1 in T.15S, R.12E., north along the west side of SW¼SW¼, then west and north around NW¼SE¼, then west and north around E½NW¼, then west to the southeast corner of Sec. 35 in T.13S., R.12E., then north along the west side of Sec. 35 to the northeast corner of Sec. 35, then west and north around E½ of Sec. 26, then west along the northern side of Sec. 26 W½, 27, and 28 to the intersection with BLM Route SF291 (transmission power line service road), then northwest on BLM Route SF291 to the northern side of Sec. 28 in T.12S., R.11E., then west on the north side of Sec. 28 to the southeast corner of Sec. 20, then north on the east side of Sec. 20 to Highway 86, then northwest on Highway 86 to the northern side of Sec. 20, then west on the northern side of Sec. 20 to the southeast corner of Sec. 18 in T.12S., R.11E., then north along the east side of Sec. 18 to Highway 78;

[North boundary] then west on Highway 78 to the west side of Sec. 18 in T.12S., R.10E.;

[West boundary] then south on the west side of Sec. 18 in T.12S., R.10E., then west on the north side of Sec. 24 in T.12S., R.9E. to the west side of Tarantula Wash, then southeast along the west side of Tarantula Wash to the south side of Sec. 24, then east to the northwest corner of Sec. 30 in T.12S., R.10E., then south along the west side of Sec. 30 and east along the south side of Sec. 30, then south on the west side of Sec. 32 and east along the south side of Sec. 32 to Carrizo Wash near the northeast corner of Sec. 5 in T.13S., R.10E., then south along the west side of Carrizo Wash through Sec. 5, 8, 17, 20, 29, and 32 in T.13S., R.10E., and then south through Sec. 5, 8, 17, 20, 29, and 32 in T.14S., R.10E. to the intersection with BLM Route SF397 in NW¼ Sec. 32 in T.14S., R.10E., then southeast on BLM Route SF397 to an unnamed, east-west route along the northern side of the SW¼SE¼ Sec. 15 in T.15S, R.10E., then west about .25 miles to the boundary of the U.S. Navy Target 103 at about the northwest corner of SE¼SE¼ Sec. 15, then south along the boundary of Target 103 (approximately west side of SE¼SE¼ Sec. 15 and E½E½ Sec. 22 to the south side of Sec. 22 in T.15S, R.10E.,

[South boundary] then (along the boundary of Target 103) east on the south side of Sec. 22 and east and south around NW¼ of Sec. 26 in T.15S, R.10E., then east along the south side of NE¼ of Sec. 26 and N½ Sec. 25, in T.15S., R.10E., and N½ Sec. 30 and NW¼ Sec. 19, in T.15S., R.11E., then north along the east side of NW¼ Sec. 19, then north and east around the S½SW¼ Sec. 20, then north along the east side of Sec. 20 and 17, then east along the south side of Sec. 9, then north along the east side of Sec. 9, then east along the north side of Sec. 10, then north along the east side of Sec. 3, in T.15S., R.11E and along the east side of Sec. 34 and 27 in T.14S., R.11E, then diagonally from the southeast corner to the northwest corner across Sec. 22, the west along the north side of Sec. 21, then north on the east side of Sec. 17 to the 120-ft. contour line, then northwest on this contour line to the intersection with BLM Route SF274 in Sec. 17 T.14S., R.11E., then northwest on BLM Route SF274 to the intersection with BLM Route SF391 in Sec. 6 T.14S., R.11E., then southwest on BLM Route SF391 to the boundary of U.S. Navy Target 101 in Sec. 32 T.14S., R.12E., then southeast along the boundary of Target 101 to the southwest corner of Sec. 34 in T.14S., R.12E., then west on the south side of Sec. 34, 35, and 36 in T.14S., R.12E., then south along the west side of Sec. 30 in T.14S., R. 13E., then along the south side of Sec. 30 to the southeast corner of Sec. 30.

QUAD SHEETS:

East boundary - Brawley NW, Calipatria SW, Kane Spring, Kane Spring NE.

North boundary - Kane Spring NE, Kane Spring NW.

West boundary - Kane Spring NW, Harpers Well, Plaster City NW, Painted Gorge.

South boundary - Painted Gorge, Plaster City, Superstition Mountain, Brawley NW.

Description of Yuha Desert Flat-tailed Horned Lizard Management Area

All are San Bernardino Meridian.

[East boundary] Beginning at the International Boundary Road on the east side of Sec. 19 in T.17S., R.13E., then north along the eastern edge of public lands lying west of the Westside Main Canal Service Road in T.17S., R.13E.; T.17S., R.12E.; and T.16½S., R.12E. to Interstate Highway 8;

[North boundary] then east along the south side of Interstate Highway 8 to the west side of Sec. 30 in T.16S., R.11E.;

[West boundary] then south along the west side of Sec. 30 and 31 (T.16S., R.11E.) about 1.5 miles to the intersection with BLM Route Y1929, then south on BLM Route Y1929 to BLM Route 2716 in Sec. 12 in T.17S, R.10E., then south on BLM Route Y2716, to BLM Route Y2722 in Sec. 11 in T.17S, R.10E., then south to the International Boundary Road;

[South boundary] then east along the International Boundary Road to the east side of Sec. 19 in T.17S., R.13E.

QUAD SHEETS:

East boundary - Mount Signal, Yuha Basin, Plaster City.

North boundary - Plaster City, Painted Gorge.

West boundary - Painted Gorge, Coyote Wells.

South boundary - Coyote Wells, Yuha Basin, Mount Signal.

Description of Borrego Badlands Flat-tailed Horned Lizard Management Area

All are San Bernardino Meridian.

[East boundary] Beginning at the road near the northeast corner of the SE¼ of Sec. 32 (unsurveyed) in T.11S., R.8E., then north along the east side of Sec. 32, 29, 20, and 17 (unsurveyed), then east on the south side of Sec. 9 and 10 in T.11S., R.8E. to the east side of the east fork of Palo Verde Wash in Sec. 10, then northwest and north along the east side of Palo Verde Wash to Borrego Springs Highway, then northwest along Borrego Springs Highway to the intersection with Truckhaven Trail in NE¼SW¼ Sec. 13 in T.10S., R.7E., then west on Truckhaven Trail to the 800-ft. contour line in NE¼NW¼ Sec. 14, then north and northwest along the 800-ft. contour line through Sec. 14, 11, 12, 1, and 2 in T.10S, R7E and Sec. 35, 34, 27, 28, 21, and 20 in T.9S., R.7E. to the northern side of Sec. 20 in T.9S., R.7E;

[North boundary] then west along the northern side of Sec. 20 and 19 in T.9S., R.7E. and the northern side of Sec. 24 and 23 in T.9S., R.6E. to the northwest corner of Sec. 23;

[West boundary] then south on the west side of Sec. 23 in T.9S., R.6E. to the intersection with the Rockhouse Trail in ¼SW¼NW Sec. 23, then southeast on Rockhouse Trail (west fork in Sec. 36, 1, 6, 7) through Sec. 23, 26, 25, and 36 in T.9S., R.6E. and Sec. 1 in T.10S., R.6E. and Sec. 6 and 7 in T.10S., R.7E. to the northwest corner of Sec. 17 in T.10S., R.7E., then east along the northern side of Sec. 17, then south along the eastern side of Sec. 16, 21, 28, and 33 in Sec. T.10S., R.7E. and the eastern side of Sec. 4, 9, 16, and NW¼ Sec. 21 in T.11S., R.7E. to the southwest corner of NW¼ Sec. 16;

[South boundary] then west on the south side of NW¼ of Sec. 21 then south on the south side of E½ Sec. 21, then east on the south side of Sec. 21, 22, and 23 to the Borrego Mountain Wash Jeep Trail in Sec. 23 in T.11S., R.7E., then north along the Borrego Mountain Wash Jeep Trail to the intersection with the San Felipe Creek Road in SW¼SE¼ Sec. 14, then west along the San Felipe Creek Road to the east side of Sec. 32 (unsurveyed) in T.11S., R.8E.

QUAD SHEETS:

East boundary - Borrego Mountain, Fonts Point, Clark Lake, Clark Lake NE.

North boundary - Clark Lake NE.

West boundary - Clark Lake NE, Clark Lake, Borrego Sink

South boundary - Borrego Sink, Borrego Mountain

Description of Ocotillo Wells Flat-tailed Horned Lizard Research Area

All are San Bernardino Meridian.

East boundary Beginning at the intersection of Highway 86 and Highway 78 in Sec. 17 in T.12S, R.11E., then north along Highway 86 to the north side of Sec. 9 in T.11S., R.10E.;

North boundary then west on the northern side of Sec. 9, 8, and 7 in T.11S., R.10E., then north on the east side of Sec. 1 in T.11S., R.9E to the intersection with the northern fork of Arroyo Salada Wash in ¼NE¼NE¼NE of Sec. 1., then northwest along this wash through Sec. 36 in T.10S., R.9E. and east through N½N½ Sec. 35 and 34 to the intersection with Truckhaven Trail in NE¼NE¼, then west on Truckhaven Trail to the west side of Sec. 30 (Imperial/San Diego County Line);

West boundary then south on the west side Sec. 30 and 31 in T.10S., R.9E. and the west side of Sec. 6 and 7 in T.11S., R.9E to a point about 0.6 miles south of the northwest corner of Sec. 7, then due west 4 miles, then due south along the west side of Sec. 16, 21, 28, and 33 in T.11S., R.8E. and the west side of Sec. 4 in T.12S., R.8E. to Highway 78;

South boundary then east on Highway 78 to the intersection with Highway 86.

QUAD SHEETS:

East boundary - Kane Spring NE, Kane Spring NW.

North boundary - Kane Spring NW, Truckhaven, Seventeen Palms.

West boundary - Seventeen Palms, Shell Reef, Borrego Mountain.

South boundary - Borrego Mountain, Kane Spring NW, Kane Spring NE.

Appendix 4. Population Monitoring Protocol

Introduction

This protocol describes how to establish and survey 12 plots on a MA and is based on Wright and Grant's (2002) surveys of the Yuha Desert MA.

Plot selection

The MA can be stratified based on coarse habitat differences (three strata were defined based on substrate in the Yuha Desert MA). The 12 plots should be divided between strata. Plots should be randomly selected from within the strata. Each plot should measure 200 x 200 m (4 ha; 10 acres). Divide the plot into 20, 10 m-wide north/south lanes using pin flags (this takes 400 pin flags and about a day of work).

Disturbance surveying

Data on substrate and disturbance should be collected for each plot in a separate procedure (usually after flagging the plot on the first day). Each of the three technicians walks the flag lines (one beginning at each end and one beginning in the middle), and records the substrate and disturbance category at the tip of his/her toe on every tenth step until each technician has recorded 100 point observations (see data sheet in Appendix 8). A vehicle track is recorded if the point was in a vehicle track of any kind of any age. Two digital photos should also be taken at each plot, from the middle of the north and south sides, facing into the plot.

Lizard surveying

All surveys shall be conducted from April through September when air temperatures are between 25 and 37 °C (75 and 100 °F) (Young and Young 2000). Each plot is to be surveyed by three technicians looking for lizards while walking side by side in each lane, taking care to search the whole plot thoroughly. Technicians should begin searching 20 minutes before sunrise. The entire plot should be searched in a morning before temperatures get too hot for the lizards to be on the surface (it generally takes three people two to four hours per plot). Each plot should be surveyed for five consecutive days.

When a FTHL is found, all data on the Horned Lizard Observation Data Sheet (see Appendix 8) should be filled in completely. Additional data to be collected while walking the plot includes number of horned lizard scat seen and other lizard species observed.

To minimize survey variance, always use the same number of people each day on a plot and use the same people on a plot for all survey days. Try to search for the same amount of time each day, and only search all areas and lanes of the plot once a day, giving equal effort to each area of the plot. Rotate where you start the plot each day from one side to the other and then from the center in either direction, thus ensuring that each portion of the plot is searched under the ideal temperature regime.

Data analysis

Capture histories are to be analyzed using the computer program MARK (Otis *et al.* 1978; White and Burnham 1999), which gives an estimate of the population using the plot. Population estimates for adults and juveniles (<60 mm SVL) should be obtained separately. The most

appropriate model, as determined by MARK's model selection procedure (using Akaike's Criterion and M(0) as a baseline), should be used for abundance estimates, although models determined to have unrealistic assumptions (i.e., regarding individual capture heterogeneity, capture response, or temporal variability) may be disregarded. The population calculated by MARK can't simply be divided by 4 ha to get a density estimate (Otis *et al.* 1978). More lizards use the plot over time than are on the plot at any single time. Many home ranges are only partially in the plot. To calculate density, the mean maximum distance moved (MMDM) method of Wilson and Anderson (1985) should be used. This method adds a boundary strip around the plot using the observed recapture distances during the survey as an index of home range size for that site/year. This method is more appropriate than using a set boundary based on home range averages because FTHL home range size varies according to habitat, gender, size, density of lizards, how wet the year is and how long you follow the lizard (Young and Young 2000; Setser 2001; Young, pers. obs.; Kirk Setser, pers. comm.).

Appendix 5. Distribution Monitoring Protocol

Distribution shall be monitored through one-hour presence/absence surveys at one-hectare (100 x 100 m) [2.5 acre (330 x 330 ft.)] sample points. All surveys shall be conducted from April through September when air temperatures are between 25 and 37 °C (75 and 100 °F) (Young and Young 2000). Surveys should be conducted by personnel who have demonstrated competence at locating FTHLs. The distribution monitoring datasheet in Appendix 8 should be used for data collection. Each sample point should be surveyed by only one person, but it is recommended that researchers work in pairs (drive together to the general area and split up to survey nearby sample points).

Key Areas

Within each MA, two permanent key areas will be selected for long-term monitoring. These key areas will serve as an early warning system where localized population declines can be detected before becoming widespread. Hence, key areas should be selected in areas of known or suspected habitat decline, most likely on the margins of the MA. Key areas can be of any shape, but should be four square miles (10.4 km^2) in total area. A control area, also four square miles, should be selected in the interior of the MA away from disturbances, to serve as a control against which changes in distribution within key areas can be compared. Within each area, 30 permanent one-hectare sample points should be randomly selected. Thirty additional sample points should be randomly selected from outside the control and key areas. These last 30 points are for refining the predictive distribution model over time and should not be permanent. Choose all sample points ahead of time and assign an identifying number to each. Vary which area you sample from week to week to avoid a seasonal bias. Sample each point only once each year. In subsequent years, resample the permanent points in the control and key areas, but select new random points for model refinement.

Monitoring Protocol at Sample Points

To survey, navigate to a sample point with a GPS unit, put down a tall pin flag to mark the position (the center of the hectare), note the starting time, then take a digital photo from the middle point, facing whichever direction you feel best represents the average habitat of that hectare. Spend up to one hour searching carefully within a 50-meter radius of the flag. Measure disturbance and other variables of interest during your initial search by collecting 50 “toe point” samples. This is done by walking north/south transects spaced 10-20 m apart and recording whether there is a vehicle track (of any size or age) or other variable of interest (e.g. galleta grass) within two m (6.5 ft) of every 10th footstep (if you encounter a horned lizard track while doing toe point samples, pause the sampling and follow the track—you can finish your sampling later). If you encountered a FTHL while measuring disturbance, no additional searching is needed. If you did not encounter a FTHL, continue surveying in any fashion that gives good coverage of the hectare and maximizes the chance of encountering a FTHL (tracking is encouraged when conditions allow). Note presence of scat, but focus on finding a lizard. The survey ends after one hour, or as soon as a FTHL is found and disturbance data have been gathered. Note end time, check that all data are filled out and then (if conditions permit) navigate to the next sample point (with a goal of completing two or three samples per person each morning).

Data analysis

The presence or absence of FTHLs (represented as a 1 or 0 respectively) at each location serves as the dependent variable to be used in conjunction with GIS overlays that represent various habitat features (the independent variables) in a logistic regression model. Using a recently developed ArcView extension, StatMod (Garrard, 2002), the goal is to create a predictive spatial model of FTHL occurrence within the MA and surrounding area. Such a model predicts probability of presence, and should indicate areas of high and low importance to the lizard. Proximity to roads and agriculture, as well as disturbance from OHV activity (if available as GIS overlays) can also be used as predictor variables, thus allowing assessment of their effects upon FTHL occurrence.

StatMod samples the independent variables at each survey point, and the resulting data set is used to create the model. The user has great flexibility in model creation (e.g. selecting which independent variables will be used in the model through either backward elimination, forward selection, stepwise selection, no selection, or specifying certain variables that must be included). Careful thought should be given to the choice of independent variables and to the settings for model parameters. Either categorical or continuous predictor variables may be used. It is recommended that Chris Garrard (Utah State University), or another statistician familiar with spatial modeling, be consulted prior to undertaking any analyses. The StatMod extension and a user's guide are available (at no cost) at http://bioweb.usu.edu/gistools/statmod/ but to run the logistic regression model requires ArcView 3.2 and SAS statistical software. The model can be refined as additional survey data are collected.

Appendix 6. Project Evaluation Protocol

Introduction

The objective of this protocol is to provide an assessment of FTHL presence or absence at proposed project sites within FTHL habitat on federal lands outside of MAs, to determine whether mitigation may be required (mitigation and compensation are automatically required on MAs, and compensation is required on all historic FTHL habitat on signatory lands outside of MAs). If the results indicate the species is present in a proposed project area, that project will be subject to appropriate mitigation and compensation. Surveys to determine presence or absence of the species are only required in areas of unknown occurrence (mitigation and compensation are automatically required in areas of known occurrence). However, a project proponent can forego these surveys by assuming the species is present and applying appropriate mitigation and compensation. If less than 20 acres of continuous potential habitat remain on and adjacent to the project site, no surveys or mitigation will be required (but compensation will still be required).

Areas of Known Occurrence

Resource and land management agencies have mapped areas of known FTHL occurrence (Figure 2). Within the historical range, assume the species is present if:

1. There is a locality record within two miles; and
2. the habitat is continuous (i.e., not divided by impermeable barriers such as a canal) and suitable between the locality and the project site; and
3. major habitat alteration or conversion has not taken place since the species was detected.

Areas of Unknown Occurrence

In areas of potentially suitable habitat within or on the edge of the species' range (Figure 2) in which presence is not assumed, surveys must be conducted to determine the presence or absence of FTHLs at project sites prior to project initiation. If the surveys indicate FTHLs are present at the project site, then mitigation and compensation will be required. If all survey requirements are met and the species is deemed absent, then mitigation is not required.

Required Authorizations and Qualifications

Only persons authorized by AGFD (in Arizona) or CDFG (in California) shall conduct surveys and handle FTHLs. Investigators shall have experience in surveying for FTHLs, including ability to recognize and follow FTHL tracks, or shall obtain training from an experienced investigator. Prior to any survey effort, a survey proposal shall be developed and approved by AGFD (in Arizona), CDFG (in California), and/or by the state or federal agency that manages the lands to be surveyed.

Survey Protocol

Although investigators shall focus on finding horned lizards, both scat and horned lizards shall be noted. All surveys shall be conducted from April through September when air temperatures are between 25 and 37 ^{o}C (75 and 100 ^{o}F) (Young and Young 2000). For projects that will impact less than nine hectares (22 acres), surveys should cover an area of at least nine hectares, centered on the proposed project site (unless one or more edges of the project site are unsuitable habitat, in

which case the surveys would be conducted in adjacent suitable habitat). A minimum of four one-hour presence/absence surveys (Appendix 5) shall be conducted in this area, with one of the surveys centered on the project site.

For larger projects the number of one-hour presence/absence surveys will increase in the following manner:

Project impact size (ha)	Number of one-hour presence/absence surveys
10-25	4
26-50	6
51-100	8
100-260 (1 section)	10
> 260	10 per section

Road Surveys

FTHLS are often easier to detect on roadways than during walking surveys. Thus, road surveys shall also be conducted and shall consist of driving all roads at least twice in or near the survey area and recording any horned lizards observed. Workers should drive very slowly (no more than 10 miles per hour on unpaved roads) to allow detection of lizards. Road surveys should be conducted from April through September primarily in the morning when air temperatures range from 25 to 37 ^{o}C (Young and Young 2000).

Data Records

The location of transects, and each FTHL, desert horned lizard, and horned lizard scat found during walking or road surveys shall be recorded on maps of scale no less than 1:24,000. Date and time observed, and (if captured) sex and snout-vent length shall be recorded for each horned lizard observed. A 35-mm color photograph with the lizard filling at least half of the frame shall be taken of each horned lizard. A sample of horned lizard scat shall be collected. A qualitative assessment of the habitat should be conducted, including listing dominant perennial and annual plants, substrate types, and level of disturbance (note roads, OHV tracks, vegetation removal, etc.) Photographs can be used to document habitat characteristics. Survey dates, and beginning and ending times and surface temperatures of each survey shall be recorded. Any blocks of time not actually spent conducting the survey shall be subtracted from the total survey time. Data collected during walking surveys shall be recorded on the attached sample survey form. Survey results shall be detailed in a report to which all survey forms and data on lizards, including photographs and maps, shall be appended.

Interpretation of Survey Results

The following criteria shall be used to derive presence or absence of the FTHL from the survey results:

Species present if:

1. FTHLs are found; or
2. Horned lizard scat is found and the desert horned lizard is unlikely to occur at the project site; or, as noted previously,
3. No FTHLs are found; but
    a) FTHLs have been found within two miles of the project site, and
    b) The habitat is continuous or suitable between the locality and the project site.

Species absent if:

1. No scat or horned lizards are found; and
    a) No FTHLs have been found within two miles of the project site; or
    b) FTHL locality record(s) exist within two miles, but the habitat is not continuous or suitable between the locality and project site; or
2. Scat is found, no FTHLs are found, but desert horned lizards occur within two miles of the project site; and
    a) No FTHL locality record(s) exist within two miles of the project site; or
    b) FTHL locality record(s) exist within two miles, but the habitat is not continuous or suitable between the locality and project site.

If, based on the above analysis, FTHLs are deemed present, locality records, scat occurrence, and descriptions of habitat shall be sent to the ICC secretary to update the distribution map.

Appendix 7. Fencing and Removal Survey Protocols

In accordance with Measure 8 of the Mitigation section, sites of permanent or long-term (greater than one year) projects in MAs where continuing activities are planned and where FTHL mortality could occur may be enclosed with FTHL barrier fencing. After clearing the enclosed area of horned lizards following the protocol described in this appendix, no on-site monitor is required (see Measure 7 of the Mitigation section). Fencing for the purpose of producing a FTHL barrier along roads (see Mitigation Measure 10) shall also follow these protocols as applicable. Prior to any fencing or removal survey, a proposal shall be developed and approved by AGFD (in Arizona), CDFG (in California), and/or by the state or federal agency that manages the lands to be surveyed.

Fencing Protocol

Barrier fences for the exclusion of FTHLs shall follow these specifications:

1) The barrier fence shall be constructed along the entire perimeter of the project and be inset sufficiently from the perimeter of the parcel to allow for construction and maintenance.
2) Barrier material shall be 0.25” mesh hardware cloth and 36” in height
3) Barrier material shall be buried 6” deep, providing 30” above the surface.
4) Barrier material shall be securely attached to t-posts or fence posts and barbed wire strung at heights of 15” and 30” (A third barbed wire shall be strung above the FTHL proof fencing), using metal clips or wire.
5) Additional t-posts or fence posts shall be placed at any junctions between rolls of hardware cloth to discourage the formation of gaps.
6) An experienced biological monitor shall oversee the construction of the barrier fence and be on-site to search for and remove FTHLs during surface-disturbing activities.
7) The entire fence shall be maintained in perpetuity, including but not limited to the repair of gaps under or in the fence, and accumulation of plant debris or sand on the outside of the fence.
8) Biological monitors shall conduct a removal survey, following the protocol below, only after the fence construction is completed.

Removal Survey Protocol

Removal surveys shall be conducted after barrier fence completion and prior to construction activities. Surveys shall follow these guidelines:

1) Surveys shall be conducted by experienced biological monitors as described in Appendix 6.
2) Surveys shall occur only during appropriate survey conditions as described in Appendix 6
3) Projects < 4 acres (1.6 ha) in size require four hours of survey effort. For larger projects, minimum survey effort shall be 0.5 hour per acre. The land managing agency may require a greater survey effort.

4) Survey methods shall be designed to achieve a maximal capture rate and shall include but not be limited to the following: strip transects, tracking, and raking around shrubs.

5) Survey methods shall incorporate a systematic component to ensure that the entire fenced project site is surveyed. A modification of the Population Monitoring Protocol (Appendix 7) may be used.

Appendix 8. Forms and Data Sheets

Population Monitoring Data Sheet

MA: _____ Plot#: ____ Technicians: _____

Corner locations (NAD 27 projection, UTM Zone _____) NW _____ , _____SW _____, _____

NE _____ , _____ SE _____ , _____ Photo ID #'s _____ ,_____ Dominant Vegetation _____

Habitat Inventory (report totals from 300 point obs here): OHV trails _ Fine sand (< 0.5 mm):_____Coarse sand (0.5 – 1.0 mm):_____Gravel (> 1 – 30 mm):____ Rock (> 30 mm): ___

5 DAY CAPTURE HISTORY TABLE

	DAY 1		DAY 2		DAY 3		DAY 4		DAY 5		Start Date:
Start/End times											
Start/End temps											**End Date:**
Start corner											

Record UTM (NAD 27) of capture for each day caught (or mark '0' if not seen). Record full capture data of each lizard's initial capture on the Horned Lizard Observation data sheet

ID	SEX[1]	AGE[2]	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	CAP. HIST.[3]
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15[4]								

[1]Sex categories: 0 = female, 1 = male. [2]Age categories: 0 = hatchling = < 40 mm; 1 = juvenile = 40-60 mm; 2 = adult = > 60 mm. [3]Series of five 0's and 1's where 1 = caught, 0 = not seen. Compile capture histories for each animal at the end of the 5 survey days. [4]If more than 15 individuals are captured on a plot, use an additional data sheet.

Distribution Monitoring Data Sheet **Sheet #______________**

(Time should be recorded in 24:00 clock) Use NAD27 projection and **specify UTM Zone________**

Observer	Date	Start time	End time	Easting (UTM)	Northing (UTM)	Plot #	Photo #
NOTES:							

FTHL	DHL	Scat	GrSq	Ztail	<500 m from development?	Disturbance	Ggrass
Record these as 1 = present; 0 = absent. Record FTHL measurements on FTHL observation data sheet.					If yes, specify type (road, ag, housing)	Values between 0 and 50 from toe-point samples	

Observer	Date	Start time	End time	Easting (UTM)	Northing (UTM)	Plot #	Photo #
NOTES:							

FTHL	DHL	Scat	GrSq	Ztail	<500 m from development?	Disturbance	Ggrass
Record these as 1 = present; 0 = absent. Record FTHL measurements on FTHL observation data sheet.					If yes, specify type (road, ag, housing)	Values between 0 and 50 from toe-point samples	

Observer	Date	Start time	End time	Easting (UTM)	Northing (UTM)	Plot #	Photo #
NOTES:							

FTHL	DHL	Scat	GrSq	Ztail	<500 m from development?	Disturbance	Ggrass
Record these as 1 = present; 0 = absent. Record FTHL measurements on FTHL observation data sheet.					If yes, specify type (road, ag, housing)	Values between 0 and 50 from toe-point samples	

Horned Lizard Observation Data Sheet

Sheet #______________

(Time should be recorded in 24:00 clock) Use NAD27 projection and **specify UTM Zone________**

Observer		**Date**		**Time**	**Easting (UTM)**	**Northing (UTM)**	**Plot #**	**I.D. #**	**Photo #**
Species		**Sex**		SVL **(mm)**	**Weight (g)**	**Notes:**			
FTHL	DHL	M	F						
Observer		**Date**		**Time**	**Easting (UTM)**	**Northing (UTM)**	**Plot #**	**I.D. #**	**Photo #**
Species		**Sex**		SVL **(mm)**	**Weight (g)**	**Notes:**			
FTHL	DHL	M	F						
Observer		**Date**		**Time**	**Easting (UTM)**	**Northing (UTM)**	**Plot #**	**I.D. #**	**Photo #**
Species		**Sex**		SVL **(mm)**	**Weight (g)**	**Notes:**			
FTHL	DHL	M	F						
Observer		**Date**		**Time**	**Easting (UTM)**	**Northing (UTM)**	**Plot #**	**I.D. #**	**Photo #**
Species		**Sex**		SVL **(mm)**	**Weight (g)**	**Notes:**			
FTHL	DHL	M	F						
Observer		**Date**		**Time**	**Easting (UTM)**	**Northing (UTM)**	**Plot #**	**I.D. #**	**Photo #**
Species		**Sex**		SVL **(mm)**	**Weight (g)**	**Notes:**			
FTHL	DHL	M	F						
Observer		**Date**		**Time**	**Easting (UTM)**	**Northing (UTM)**	**Plot #**	**I.D. #**	**Photo #**
Species		**Sex**		SVL **(mm)**	**Weight (g)**	**Notes:**			
FTHL	DHL	M	F						
Observer		**Date**		**Time**	**Easting (UTM)**	**Northing (UTM)**	**Plot #**	**I.D. #**	**Photo #**
Species		**Sex**		SVL **(mm)**	**Weight (g)**	**Notes:**			
FTHL	DHL	M	F						

Project Reporting Form

for Projects or Activities that Disturb Flat-tailed Horned Lizard Habitat

*This form is to be filled out before project initiation **and** after project completion.*

If this form is used for reporting unauthorized disturbances (within or outside of MAs*), document all information sources, preferably with publicly available documents. In all cases, respect private property rights.*

PROJECT DESCRIPTION/LOCATION:
Project Number:_____Authorizing Agency:_____Field Contact Rep:_____
Project name/description:_____
Project proponent:_____ Authorized:___ Unauthorized:___

Project type: Construction___ Military Maneuver___ Land Disposal___ Maintenance of Existing Project___ Intrusive Research___ Recreation/Interpretive Development___ Mining (includes sand and gravel)___
Other (describe)_____

Project location: (attach map showing location and footprint of project)
Within MA___ (indicate which MA)_____
Outside MA___Township_____ Range_____ Section_____ 1/4 Section_____

EFFECTS OF THE PROJECT:
Growth inducing effects: Yes___ No___ **Previously disturbed:** Yes___ No___ Partly___
Duration of effect: Short term (<10 yrs)___ Long term (≥10 yrs)___ **New access:** Yes___ No___
Acres lost as habitat:_____ Acres degraded:_____
Lands outside project footprint: Not affected_____ Adversely affected_____

MITIGATION/COMPENSATION:
Mitigation required: Yes___ No___ **Mitigation plan:** Yes___ No___ **Mitigation type:** Construction limited to 11/15-2/15___ Worker education___ Location altered___ FCR___ Define and limit work areas___ Biological monitor___ Preconstruction surveys___ Perimeter lizard fence___ Restoration___ Post-project monitoring___Other_____
_____

Compensation required: Yes___ No___ **Compensation type:** $(amount)_____ Lands(acres):_____
If compensation is lands: Lands transferred to:_____
Location of lands:_____

FTHL ***OBSERVATIONS***:
FTHL Observed on Project Site: Yes___ No___ **If Yes, fill out the FTHL Observation Data Sheet**
#FTHLs relocated_____ #FTHLs killed_____ #FTHLs injured_____

COMMENTS:_____(continue other side if needed)

Preparer (print):_____ Title:_____

Signature:_____ Date:_____

Mail a copy of this form and any additional data to the Secretary of the Interagency Coordinating Committee

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