

Flat-tailed Horned Lizard
Rangewide Management Strategy

Prepared by

**Flat-tailed Horned Lizard
Working Group of
Interagency Coordinating Committee**

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May 1997

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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 viable populations of flat-tailed horned lizards (*Phrynosoma mcallii*). The species is found only in southwestern Arizona, southeastern California, and adjacent portions of Sonora and Baja California Norte, Mexico.

The species was proposed for listing as a threatened species by the U. S. Fish and Wildlife Service (USFWS) on November 29, 1993. Human activities have resulted in the conversion of roughly 34 percent of the historic habitat of the flat-tailed horned lizard to other uses, such as agriculture and urban development. Evidence suggests that populations of this species have declined in some of the remaining habitat areas.

The Rangewide Management Strategy calls for the establishment of five flat-tailed horned lizard management areas - four in California and one in Arizona. Surface disturbing activities would be limited in these areas. Land alterations outside of these management areas would not be restricted, but special mitigation and compensation measures would be applied. In addition, one research area is proposed, where research is encouraged. Local agencies and private landowners are encouraged to establish one additional management area in the Coachella Valley in California.

The Rangewide Management Strategy was prepared by representatives from Federal, state, and local governments. It is designed to be used as the basis for a conservation agreement among the agencies. Signatory agencies will incorporate measures in the Rangewide Strategy into their land management plans. Compliance with the National Environmental Policy Act and state counterparts will be achieved through these management plans or revisions. The planned actions in the Rangewide Management Strategy are organized in a step-down format used by the USFWS in recovery plans.

Recommended Citation:

Foreman, L. D. (Ed.) 1997. Flat-tailed horned lizard rangewide management strategy. Report of interagency working group. 61pp. plus appendices.

Introduction

Description of Species

Taxonomy

The flat-tailed horned lizard was first described by Hallowell in 1852 as *Anota mcallii* after U.S. Army Colonel George A. M'Call who collected the first type specimen (Johnson and Spicer 1985). Due to the lack of external ear openings, the flat-tailed horned lizard 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*. No subspecies of flat-tailed horned lizard (*Phrynosoma mcallii*) have been described (Funk 1981).

Field Characters

The flat-tailed horned lizard has the typical 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 flat-tailed horned lizard 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. Maximum snout-vent length for the species is 8.4 cm (Muth and Fisher 1992), while of hatchlings range from 3.0 to 3.8 cm (Johnson and Spicer 1985).

The only other horned lizard known to be sympatric with the flat-tailed horned lizard is the desert horned lizard (*Phrynosoma platyrhinos*). The latter is distinguished from the flat-tailed horned lizard 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. Apparent hybrids between the two species, exhibiting a mix of morphological characteristics, have been observed in the vicinity of Ocotillo, California (Stebbins 1985).

Listing History

In California, the flat-tailed horned lizard was designated a sensitive species by the Bureau of Land Management (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 flat-tailed horned lizards 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 Fish and Game Commission received a petition requesting listing of the flat-tailed horned lizard as an endangered species. On May 13, 1988, the Commission accepted the petition and designated the flat-tailed horned lizard a candidate species. The California Department of Fish and Game (CDFG) reviewed the petition and other information; the CDFG 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 has the flat-tailed horned lizard on its 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. Collection of flat-tailed horned lizards is prohibited in both Arizona and California, except by special permit.

The USFWS included the flat-tailed horned lizard 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 Carlson and Mayhew 1988, Olech undated, and Rorabaugh *et al.* 1987), the USFWS elevated the flat-tailed horned lizard 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 flat-tailed horned lizard 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, off-highway vehicle use, energy developments, and military activities" as the primary bases for the proposed listing. The USFWS found that critical habitat was not determinable at that time. A public meeting was held in El Centro on March 22, 1994, to gather public comment. At this time, no final rule on the proposed listing has been issued.

The Mexican Government has designated the flat-tailed horned lizard a threatened species. As such, the species is protected from collection, sale, and commerce, and its habitat is afforded special protection (Secretaria de Desarrollo Social 1994).

Distribution

The flat-tailed horned lizard is found in the extreme southwestern corner of Arizona, the southeastern corner of California, and adjoining portions of Sonora and Baja California, Mexico (Figure 1). In Arizona, the flat-tailed horned lizard is found in southern Yuma County, primarily south of Interstate 8 and west of the Gila Mountains. Estimates of suitable habitat in Arizona have ranged from 135,900 to 176,000 acres (Johnson and Spicer 1985, Rorabaugh *et al.* 1987, Hodges 1995). Suitable habitat is found east and south of the City of Yuma outside of the Colorado River floodplain and adjoining croplands. Lands within the range of the flat-tailed horned lizard in Arizona include Federal lands administered by the Marine Corps Air Station at Yuma, the BLM, and the Bureau of Reclamation (BR); State of Arizona lands; and private lands. The majority of the flat-tailed horned lizard's range in Arizona is on the Barry M. Goldwater Range.

The flat-tailed horned lizard is found in California in portions of eastern San Diego County, central Riverside County, and Imperial County. The majority of the habitat for the species is in Imperial County (Turner *et al.* 1980). The range of the flat-tailed horned lizard encompasses approximately 1,800,000 acres in California (Bolster and Nicol 1989, Rado 1981); however, much of the land within this range is unsuitable, including the Salton Sea and other habitats not used by the species, such as urban and agricultural areas. 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). The El Centro Resource Area (BLM, California Desert District) administers three of these areas: West Mesa, East

Mesa, and Yuha Desert. Portions of West Mesa and East Mesa are jointly managed by the BLM and the U. S. Navy. The BR has withdrawn a large portion of these areas. The California Department of Parks and Recreation (CDPR) manages much a fourth area in California, including Ocotillo Wells State Off-Highway Vehicle Area (Ocotillo Wells SVRA) and a portion of Anza-Borrego Desert State Park.

About 29 percent of the range of the flat-tailed horned lizard is in Mexico. In Baja California Norte, the range extends from the International Border west of Mexicali south to Laguna Salada. 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 Penasco and Bahia de San Jorge (Johnson and Spicer 1985, Gonzales-Romero and Alvarez-Cardenas 1989). The flat-tailed horned lizard is probably absent from the volcanic areas in the Pinacate Region and the dune fields of the Gran Desierto. Records from Sonora Highway 2,

Figure 1. Map showing general range of flat-tailed horned lizard in the United States and Mexico.

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.

Life History

Habitat Use

Flat-tailed horned lizards occur entirely within the Lower Colorado River Valley Subdivision of Sonoran Desert Scrub (Turner and Brown 1982). This is 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 temperatures range from 30 to 45°C.

Most records for flat-tailed horned lizards come from the creosote (*Larrea tridentata*)-white bursage (*Ambrosia dumosa*) series of Sonoran desertscrub (Turner and Brown 1982). It is this open community in association with sandy flats and valleys that is often described as flat-tailed horned lizard 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 flat-tailed horned lizard 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 of Sonoran desertscrub (Turner and Brown 1982), on gravelly soils in Anza-Borrego Desert State Park, and in association with senita cactus (*Lophocereus schottii*) in Sonora. Flat-tailed horned lizards are probably rare in the unvegetated portions of major dune systems, such as the Algodones Dunes and the dunes of the Gran Desierto (Luckenbach and Bury 1983, McCalvin 1993).

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. In Arizona, the presence of big galleta grass (*Hilaria rigida*) was correlated with flat-tailed horned lizard 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 flat-tailed horned lizard 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 preferred by flat-tailed horned

lizards, presumably because of their ability to trap wind-blown sand and provide shade for thermal cover.

The desert horned lizard is the only other horned lizard known to occur sympatrically with the flat-tailed horned lizard. 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 (*Cercidium microphyllum*) and ironwood (*Olneya tesota*). As described previously, flat-tailed horned lizard habitat in the near proximity was described as consisting of finer sand, more level and unbroken terrain, and sparse creosotebush-bursage vegetation.

Food Habits

Ants constituted 97 percent of the prey items in flat-tailed horned lizard scats examined by Pianka and Parker (1975) and Turner and Medica (1982). The percentage of ants in their diet is greater than other horned lizards (Pianka and Parker 1975). The most important ant species are harvester ants in the genera *Messor* and *Pogonomyrmex* (Turner and Medica 1982). Studies in California (Turner and Medica 1982) and Arizona (Turner and Medica 1982; Rorabaugh *et al.* 1987) showed positive correlations between flat-tailed horned lizard scat abundance and harvester ant nests.

Like other carnivorous desert lizards, flat-tailed horned lizards primarily use preformed water (water found in their food) to maintain proper water balance (Schmidt-Nielsen 1964). Free-standing water is not usually available in flat-tailed horned lizard 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 flat-tailed horned lizards is debatable. Mayhew (1968) states that flat-tailed horned lizards have never been seen drinking water in the wild or in captivity. However, Johnson and Spicer (1985) witnessed a captive flat-tailed horned lizard drinking water that was sprayed on it.

Reproduction

Flat-tailed horned lizards are oviparous and early maturing, and they can produce multiple clutches (Howard 1974). Two cohorts of hatchlings may be produced each year, in late July and in September (Muth and Fisher 1992). 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, flat-tailed horned lizards produce relatively small egg clutches [mean clutch size of about 5, range of 3 to 7 (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 flat-tailed horned lizard 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. A sex ratio of 1:1 (males:females) was documented in populations in California (Turner and Medica 1982, Muth and Fisher 1992).

Behavior

Unlike other iguanid lizards, which often flee when approached, flat-tailed horned lizards generally remain still (Wone and Beauchamp 1995a) or may even bury themselves in the loose sand (Norris 1949). This reluctance to move when disturbed, together with cryptic coloration and flattening of the body, makes them very difficult to locate in the field. Flat-tailed horned lizards studied by Muth and Fisher (1992) spent 54 percent of the day in some form of movement. Most activity occurred throughout the mid-day in spring and fall. As summer temperatures increase, flat-tailed horned lizards shift to two activity periods, morning and evening (Mayhew 1968).

During the active season, flat-tailed horned lizards spend the night just beneath the surface of the sand, in burrows, or on the surface (Klauber 1939, Smith 1946, Muth and Fisher 1992). At least some individuals escape extreme surface temperatures during the day by retreating to burrows they have excavated (Rorabaugh 1994). The availability of burrows, or soils friable enough for burrow construction to a depth of 10 cm, may be necessary for flat-tailed horned lizards to escape extreme temperatures (Muth and Fisher 1992, Rorabaugh 1994).

Adult flat-tailed horned lizards are obligatory hibernators; torpor cannot be prevented in winter under normal laboratory conditions (Mayhew 1968). Mayhew (1965) suspected that reduced food availability, as well as decreasing photoperiod and lower metabolic rate resulting from reduced temperature is the hibernation triggering mechanism. Adults cease eating in the fall regardless of temperature and will starve if prevented from hibernating. Winter dormancy for flat-tailed horned lizards in California began in mid-November and continued until mid-February (Muth and Fisher 1992). Mayhew (1965)

found the majority of adult flat-tailed horned lizards hibernated in burrows they had dug within 5 cm of the surface. All winter-dormant flat-tailed horned lizards found by Muth and Fisher (1992) were within 10 cm of the surface.

At least some juveniles are active during the winter (Muth and Fisher 1992). Winter activity may allow juveniles to continue growing through winter and reach reproductive maturity at an earlier age (Howard 1974, Smith and Ballinger 1994). 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).

Flat-tailed horned lizards have unusually large home ranges for lizards their size. At a West Mesa study site, the mean home range size for all flat-tailed horned lizards with more than 18 recaptures was 6.7 ac. (Muth and Fisher 1992). At a site in the Yuha Desert, Turner and Medica (1982) estimated home ranges of 0.32 ac. and 0.12 ac. for male and female flat-tailed horned lizards, respectively. However, the small size of the Yuha Desert study plot (10.1 ac.) combined with relatively few recaptures and a relatively short study period likely resulted in an underestimate of home range size.

Population Dynamics

No definitive data exist on population dynamics. However, information from scat counts (Rorabaugh 1994) and the studies of Muth and Fisher (1992) suggest that densities fluctuate greatly 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, and others.)

Flat-tailed horned lizard populations may fluctuate in response to prey availability. Harvester ant population sizes 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 flat-tailed horned lizards during periods of low precipitation (Brown *et al.* 1979).

Population Viability Analysis - The Flat-tailed Horned Lizard Conservation Team (see Appendix 6) has conducted population viability analyses with the simulation models RAMAS and VORTEX. Although not complete at this time, the Team's preliminary

work has clarified research needs and has provided some insight into the mechanisms of flat-tailed horned lizard 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 are 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 is not adequately understood to provide this information. However, the Team believes that sufficient data exist to identify variables that are most important in determining population viability. Research should be prioritized to develop accurate estimates of these variables under varying conditions, and management reserves should target altering key variables to enhance population viability.

Preliminary results with RAMAS and VORTEX suggest that population viability is particularly sensitive to changes in mortality rates. Other important variables are fecundity and the effects of environmental stochasticity, such as drought and years with above average precipitation. Fecundity and precipitation are affected minimally by management. However, by reducing activities that result in mortality, directly or indirectly, management within reserves could increase the viability of flat-tailed horned lizard populations. Thus, the preliminary population viability analyses suggest that actions that limit sources of mortality will increase the chances that populations will persist into the future. Preliminary results also highlight 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.

Current Management and Conservation of Flat-tailed Horned Lizard Habitat

Federally-administered Lands

Arizona. Title I of the Colorado River Salinity Control Act of 1974 (Public law 93-320) established a 5-mile protective and regulatory groundwater pumping zone 5 miles north of and paralleling the international boundary between Mexico and the United States. This zone, known as the "Five-Mile Zone," is in compliance with Minute 242 of the 1944 Mexican Water Treaty between the United States and Mexico. The BR uses a portion of the zone for a series of water wells and pumps, an under and above ground canal, and a series of settling ponds (Fig. 11). The ponds are used for disposing of saline sludge generated by the Yuma Desalinization Plant.

The passage of the Military Lands Withdrawal Act of 1986 (Public law 99-606) transferred land management responsibilities on the Barry M. Goldwater Range to the BLM. The BLM administers public lands within flat-tailed horned lizard habitat under both the "Yuma District Resource Management Plan" (BLM 1987a) and the "Lower Gila South Resource Management Plan (Goldwater Amendment)" (BLM 1990), which includes the Goldwater Range. Formerly part of the Lower Gila South Resource Area, this portion of the Goldwater Range is now administered by the BLM's Yuma Field Office.

On the Goldwater Range, flat-tailed horned lizard habitat occurs in portions of three special management areas: 1) the Gran Desierto Dunes Area of Critical Environmental Concern (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, off-highway vehicle use, camping, new rights-of-way, and other land use authorizations are limited.

On public lands outside the Goldwater Range, off-highway vehicle use is limited to existing roads and trails. A route designation map is available from the Range Management Officer, Marine Corps Air Station - Yuma. On the Goldwater Range, off-highway vehicle use is limited to designated roads and trails. For safety reasons, the Marine Corps Air Station, Yuma, issues range passes for visitors to the Goldwater Range. Visitors are restricted to driving street-legal vehicles, which further inhibits off-road travel.

For military activities on the Goldwater Range, the USFWS has prepared a conference report (USFWS 1996a) which provides guidance for activities affecting flat-tailed horned lizard.

California.

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 flat-tailed horned lizard - 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 flat-tailed horned lizard, the San Sebastian Marsh/San Felipe Creek ACEC (6,337 acres) and Salt Creek Desert Pupfish/Rail Habitat ACEC (4,288 acres) also contain habitat for the flat-tailed horned lizard. An expansion of the latter, to be renamed Dos Palmas ACEC, to 14,880 acres is currently in review.

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 flat-tailed horned lizard population trends, exchanges and acquisitions, and formation of an interagency coordinating committee. In response to indications of declining flat-tailed horned lizard 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, off-highway vehicle 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.

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 flat-tailed horned lizard populations were given a high priority.

In 1986, the "San Sebastian Marsh/San Felipe Creek [ACEC] Management Plan" (BLM 1986a) was signed. Based on scat counts, flat-tailed horned lizards 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.

The West Mesa ACEC was officially designated in 1986 to protect habitat of the flat-tailed horned lizard, 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.

In the early 1980's, the Coachella Valley Preserve System was established primarily for conservation of the Coachella Valley fringe-toed lizard (*Uma inornata*). Major portions of the preserve system were acquired by the BLM, USFWS, CDFG, CDPR, and The Nature Conservancy. 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 flat-tailed horned lizard habitat. 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.

A habitat management plan for the Algodones Dunes was prepared in 1987 (BLM 1987b). Based on scat counts, flat-tailed horned lizards 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.

Limited habitat for flat-tailed horned lizard is found in the Dos Palmas/Salt Creek ACEC along the northeastern side of the Salton Sea. Planning for the area is currently underway.

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.

The foundation for an inventory and monitoring program on BLM-administered land 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. Methods have been refined through the years and were standardized in 1990 (BLM and CDFG 1990). Trends on BLM-administered lands have been analyzed periodically (Olech undated, Wright 1993). In addition to BLM-administered lands, inventories of the Navy target areas (Dames & Moore 1995, Rorabaugh 1996a) and Salton Sea Naval Base (Muth and Fisher 1989, Rorabaugh 1996b) have been conducted. Research on Federal lands has been restricted to a few studies on life history (e.g., Norris 1949, Mayhew 1965, Muth and Fisher 1992) and impacts of off-highway vehicles (e.g., Olech 1986).

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. Flat-tailed horned lizards occur throughout both of these ranges. Although the ranges are withdrawn from entry for non-military uses, R-2510 is adjacent to an off-highway vehicle open area, and trespass off-highway vehicle activity occurs. R-2512 also has some off-highway vehicle 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.

About 600,000 acres, mostly in Imperial County, were withdrawn by Secretarial orders dating back to the early 1900's for use by the BR 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. The majority of these withdrawn lands are managed by the BLM under an agreement with the BR 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 BR, 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. Lands released from withdrawal will be covered by the California Desert Conservation Area Plan (BLM 1980). Lands continuing under withdrawal and covered under the earlier agreements will also be managed by the BLM.

State Lands

Arizona. The Arizona State Land Department has not developed a plan for the management of State of Arizona lands within flat-tailed horned lizard habitat. The State Land Department is processing land purchase applications for State of Arizona lands east of Yuma and near San Luis.

California. Lands within Anza-Borrego Desert State Park are managed to conserve native plant and animal communities. Mining, soil removal, grazing, rockhounding, artifact collection, hunting, shooting, and other activities that could cause surface disturbances are prohibited in the park. Flat-tailed horned lizards 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. Violators are cited by patrol rangers; backup is provided by the park's patrol aircraft. Designated roads that might impact sensitive natural or cultural resources can be closed seasonally or permanently by order of the District Superintendent. Off-highway vehicles 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 Anza-Borrego Desert State Park 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 flat-tailed horned lizards (Anza-Borrego Desert State Park Files, Mark Jorgensen, pers. comm.)

Ocotillo Wells SVRA is a 40,000-acre park managed by the CDPR, Off-Highway Motor Vehicle Recreation Division (OHMVRD). It is mandated to provide off-highway vehicle recreation in a manner to sustain long-term use. As in Anza-Borrego Desert State Park, mining, soil removal, livestock grazing, artifact collecting, hunting, and shooting are prohibited within the SVRA. No collecting of reptiles is allowed except under a scientific collecting permit issued by the CDFG and approved by the SVRA. In 1991, an extensive wildlife survey and habitat protection plan (Kutilek *et al.* 1991) were completed in the SVRA. The presence of flat-tailed horned lizards and the possibility of listing precipitated a study in 1994 (Wone *et al.* 1994) to develop methods for monitoring population trends in the SVRA. In these on-going studies, methods of monitoring of flat-tailed horned lizard population trends on permanent plots in the SVRA and on control plots are being assessed.

Mexico

Lands in El Parque Nacional del Pinacate and at 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 Biosfera de El Pinacate y Gran Desierto de Altar and Reserva de la Biosfera del Alto Golfo de California y Delta del Rio Colorado). El Parque Nacional del Pinacate is an area administered by the Mexican government with use restrictions similar to a national park in the United States. However, the boundaries are not well established, and enforcement of regulations is minimal. The Pinacate area is primarily a volcanic zone within which habitat for flat-tailed horned lizards is probably limited to the sandy northern, western, and southern perimeter. Reserva de las Biosfera Alto Golfo includes flat-tailed horned lizard habitat in the vicinity of the Colorado River Delta in Sonora.

Census and Survey Methods

The distribution and relative abundance of flat-tailed horned lizards has been estimated throughout the range of the species in California and Arizona by use of standardized transects in which numbers of flat-tailed horned lizards and their scat are 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). Two critical assumptions of the survey method are 1) flat-tailed horned lizard scat is readily distinguishable from other lizard's scat, and 2) scat and lizard counts are correlated with densities of flat-tailed horned lizards.

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 that of flat-tailed horned lizards) (Turner and Medica 1982). The relationship between scat counts and horned lizard density has never been examined, but recent work suggests that if these variables are correlated, the relationship may be weak, particularly in the case of small data sets (Muth and Fisher 1992, Rorabaugh 1994). Wright found a correlation between counts of flat-tailed horned lizards 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 flat-tailed horned lizards are observed on transects (i.e., on average less than 1 animal per 10 hours of searching)(Turner and Medica 1982, Rorabaugh *et al.* 1987) and because environmental conditions are likely to influence flat-tailed horned lizard activity and detectability.

Scat counts have also been used to estimate trends in flat-tailed horned lizard relative abundance (Olech undated, Wright 1993). High scat and flat-tailed horned lizard counts have been consistently recorded from West Mesa, Yuha Basin, near Ocotillo Wells, southern East Mesa, and the Yuma Desert (Rorabaugh *et al.* 1987, Wright 1993). These areas are also where flat-tailed horned lizards are most commonly observed. Scat counts in the same area may fluctuate greatly from year to year (Wright 1993, Rorabaugh 1994); however, mean annual counts in the Yuha Basin declined significantly from 1979 to 1993 (Wright 1993). No statistically significant trends have been detected in either southern East Mesa and West Mesa (Wright 1993). Trend data are not available for the Ocotillo Wells area or the Yuma Desert. Controlled experiments in which scat and flat-tailed horned lizard counts are conducted in areas of known flat-tailed horned lizard density are needed to evaluate the value of using transect data to estimate relative abundance and population trends.

Survey work, analyses of population demographics, and development of survey techniques is ongoing at the Ocotillo Wells SVRA (Wone *et al.* 1994, Wone *et al.* 1995, Wone and Beauchamp 1995a, 1995b). Studies funded by Department of Defense and conducted by Utah State University were initiated in 1995 on the Goldwater Range. The goals are to develop a survey protocol, determine methods for estimating population density, quantify demographics and behavior, and identify effective capture techniques.

Threats

From the historic range in Mexico and the United States, the flat-tailed horned lizard has lost approximately 34 percent of its original habitat (Johnson and Spicer 1985, Rado 1981). In the U.S., the filling of the Salton Sea from 1905 through 1907 and the periodic inundation of the Laguna Salada have removed about 320,000 acres of habitat. Rado (1981) estimated that about 315,000 acres of habitat in California had been lost to agricultural development and support facilities such as aqueducts and canals. In addition, about 83,000 acres of the original range of the flat-tailed horned lizard in California and about 16,000 acres in Arizona have been converted to urban use. Additional unknown acreage has been degraded due to utility lines, geothermal development, sand and gravel mining, off-highway vehicle use, waste disposal sites, military activities, Border Patrol activities, and roads. In remaining habitat areas, evidence suggests that populations of flat-tailed horned lizards have declined in the Yuha Basin and northern East Mesa (Wright 1993, USFWS 1993).

In Sonora less than 10 percent 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.

Several aspects of the ecology and behavior of the flat-tailed horned lizard contribute to the species' sensitivity to habitat loss and degradation. Among these are the following: 1) the flat-tailed horned lizard is distributed over a relatively small area (Figure 1); 2) relatively low clutch size may limit the ability of lizard populations to recover from declines; 3) the large home range of the flat-tailed horned lizard means that surface-disturbing activities may affect lizard populations for relatively great distances from project sites; 4) flat-tailed horned lizards often freeze in response to danger, which makes them susceptible to mortality on roads and in other areas of activity; and 5) flat-tailed horned lizards are found in valleys and flats where the majority of residential and agricultural development typically occurs.

Agricultural Development

Agricultural development has occurred primarily in the Imperial, Coachella, Mexicali, 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. Conversion to agriculture eliminates flat-tailed horned lizard habitat.

Densities of some predators are elevated at or near agricultural lands. Relatively high densities of predators (e.g., common raven, greater roadrunner, American kestrel, burrowing owl, and loggerhead shrike) may result in elevated predation on flat-tailed horned lizards in adjacent undeveloped lands.

Urbanization

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 flat-tailed habitat in the Coachella Valley, Borrego Valley, and on the Yuma Mesa near Yuma and San Luis, Arizona. This development results in a direct loss of habitat and habitat degradation resulting from a variety of human activities, such as off-highway vehicle use and other recreational activities, road construction, route proliferation, and illegal dumping of trash. Urban development may also result in increased populations of potential predators, such as common ravens and domestic dogs and cats, resulting in above natural predation rates on flat-tailed horned lizards in adjacent wildlands (Bolster and Nicol 1989). Growth is also occurring in San Luis, Sonora, including development of an 8,000-acre industrial park in flat-tailed horned lizard habitat on the east end of the city.

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, in prep) on the effects of off-highway vehicle activity. In 1983, Webb and Wilshire (1983) published a comprehensive analysis on the impacts and management of off-road vehicles in arid regions.

Legal off-highway vehicle 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 off-highway vehicle "open areas."

Illegal off-highway vehicle activity occurs in some areas but is limited by law enforcement, signing, and public information and education. The U.S. Border Patrol conducts patrols and rescues near the International Border which sometimes involves cross-country travel.

Currently, California BLM and the Ocotillo Wells SVRA permit competitive events on West Mesa and in Yuha Basin on the western side of the flat-tailed horned lizard's range. In addition, within this area, 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 Ocotillo Wells SVRA. Portions of these open areas support flat-tailed horned lizard populations in various densities.

The nature and extent of impacts of off-highway vehicle 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 flat-tailed horned lizards 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).

Off-road vehicles 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 and shelter from solar heating and wind.

In addition to the indirect effects noted above, flat-tailed horned lizards could be killed directly by being run over, either above ground or in burrows. Flat-tailed horned lizard winter burrows are shallow (average depth of 5.6 cm, range 2.6-10.0, n= 6 [Muth and Fisher 1992]); thus, burrows and lizards in burrows may be crushed by vehicles. Bury, Luckenbach, and Busack (Bury *et al.* 1977) found reduced biomass, density, and diversity of reptiles in heavily used areas of off-highway vehicle open areas.

It has been shown that prolonged noise can adversely effect 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 flat-tailed horned lizards. Effects are more likely where prolonged, loud noise occurs. A bibliography of literature on the effects of noise on animals can be found in Brattstrom (1978).

Utilities

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 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.

Habitat disturbance from pipelines results from trenching, stock piling 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).

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 meters) resulting in a small disturbance overall (usually less than 1.5 acres per mile).

Neither pipelines, transmission lines, nor fiber-optic cables are 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.

Highways, Canals, Railroads

Construction of highways, canals, and railroads eliminates linear strips of flat-tailed horned lizard habitat. Vehicles traveling on roadways may also crush flat-tailed horned lizards. Such mortality could depress local populations and perhaps function as a partial barrier to movement. Flat-tailed horned lizards are less likely to be run over on railroads, but the tracks may create a significant barrier to movements. Some may drown in large canals as well as small agricultural drains, but the significance is unknown. Canals probably function as nearly absolute barriers, with flat-tailed horned lizards able to cross only at bridges and syphons. Barriers to movement can create small, local populations which are susceptible to stochastic events and extinction (Wilcox

and Murphy 1985). For example, the Andrade Mesa, a small strip of flat-tailed horned lizard 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.

Yuma County has proposed to construct the Area Service Highway linking the Araby Road Exit on Interstate 8 and San Luis, Arizona. The proposed route would pass through approximately 10 miles of previously undisturbed flat-tailed horned lizard habitat and would upgrade and pave approximately 5 miles of an existing dirt road.

A new International Border crossing for commercial trucks is proposed to be constructed east of San Luis, Arizona. Improved access is likely to facilitate urban and industrial development, which will cause further loss of habitat on both sides of the international border.

The BR 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 (Bureau of Reclamation 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 flat-tailed horned lizard habitat would be lost (Bransfield and Rorabaugh 1993). The project is currently on hold.

Mining and Mineral Material Extraction

Mining and mineral extraction activities cause habitat loss and degradation as a result of long-term loss of vegetation cover and removal of top soil. 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.

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 flat-tailed horned lizard habitat in the southwestern portion of East Mesa. Habitat loss and degradation results from power plant construction, wells, pipelines, transmission lines, and service roads. At present, 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 flat-tailed horned lizard in the United States.

Potentially, portions of public land within the range of the flat-tailed horned lizard 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 the regulatory standards in sections 3100 to 3540 of the *43 Code of Federal Regulations*. 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.

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 flat-tailed horned lizard 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 flat-tailed horned lizards 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 flat-tailed horned lizards similar to large, regional landfills.

The Federal Government, through the General Services Administration, recently sold 640 acres of land south of Yuma to the City of Yuma for a regional landfill. The land is located just east of the Arizona State Prison along County 23rd Street (Fig. 11). The land is known to be previously undisturbed and is known to be occupied by flat-tailed horned lizards. The landfill will replace the existing Yuma County landfill located east of Somerton, Arizona.

Military Activities

Three military ranges contain flat-tailed horned lizard habitat. These include lands under airspaces R-2510 in West Mesa and R-2512 in East Mesa and the Salton Sea Test Base. R-2510 overlays target areas 101 and 103, and R-2512 overlays target areas 68 and 95. These ranges are managed by the Naval Air Facility El Centro. The third range is R-2301W located on the western half of the Barry M. Goldwater Aerial Gunnery Range, which is managed by the Marine Corps Air Station at Yuma. The Moving Sands and Cactus West Target Areas are located within R-2301W. Activities on the military ranges vary greatly from range to range and over time. Within flat-tailed horned lizard habitat activities consist of the use of inert (non-exploding) bombs, rockets, and cannon strafing of specific target areas. These targets have an impact area radius of up to 1,500 feet. There are currently five targets in use in Arizona and California. Some of the existing targets have been in use since the early 1940's.

Other activities associated with military ranges include limited ground support associated with air warfare training, clean-up of target sites, cargo parachute drops, roadway and runway maintenance, mobile target activity, and target grading, disking, and general maintenance. Most activity is confined to existing roadways and designated staging areas. Very little off-road activity is required except for special training missions or access by emergency vehicles. Foreseeable future uses of flat-tailed horned lizard habitat in Arizona are described in the Yuma Training Range Complex Draft Environmental Impact Statement; the USFWS has reviewed these activities and provided a conference report on April 17, 1996 (USFWS 1996a). No changes in current uses are anticipated on the California Ranges.

Some military activities result in small amounts of direct habitat disturbance. Effects are likely to be small except where activities are concentrated. Some incendiary devices may start wildfires. See the following section for a discussion of the effects of fire. Explosion of ordnance, aircraft noise at and near airstrips, and other sources of loud noise may cause deafness in lizards at and near the sources of such noise (Brattstrom and Bondello 1983).

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. Several small fires of less than ten acres have also been fueled by dried, non-native plants in the Coachella Valley. Habitat in portions of the Coachella Valley and on East Mesa and in Sonora support dense stands of non-native annuals and, as a result, are particularly susceptible to fire. Fires are presumably ignited by lightning strikes, campfires, highway and railroad sources, catalytic converters on off-highway vehicles, 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 flat-tailed horned lizard 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 flat-tailed horned lizard 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 flat-tailed horned lizards are on or near the surface, individuals could be killed directly by the fire. The effects of vegetation community conversion on flat-tailed horned lizards 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 flat-tailed horned lizards. 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 flat-tailed horned lizard are sprayed aerially with insecticides to control various insect pests. These pesticides may drift onto adjacent wildlands and kill ants, the primary prey of flat-tailed horned lizards (BLM 1990). Pesticide drift is less likely to be concentrated sufficiently to kill flat-tailed horned lizards directly, but dosages may become lethal if accumulated in the tissues by consuming contaminated prey. Pesticide tolerances of flat-tailed horned lizards are unknown (Johnson 1989). Drift of herbicides from croplands may also injure or kill plants in adjacent flat-tailed horned lizard habitat.

Since 1943 the California Department of Food and Agriculture has conducted a control program for the exotic beet leafhopper, 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). Figure 2 shows the requested treatment area according to current plans (Calif. Dept. of Food and Agriculture 1995). 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 aerial treatment in this program in Imperial County was in 1991. (Calif. Dept. of Food and Agriculture 1995).

Effects of malathion on the flat-tailed horned lizard have not been studied; however, studies on other lizards has shown no direct effects at applications many times higher than planned here (Hall and Clark 1982; Peterle and Giles 1964; Giles 1970). Harvester ants, which are the primary prey of flat-tailed horned lizards, could be 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). Though incomplete, previous monitoring studies have shown that ant colonies recover within a short time (Peterson 1991).

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 USWFS has recently issued a biological/conference opinion on the beet leafhopper control program (USFWS 1996b). The terms and conditions stipulate that, after the designation of flat-tailed horned lizard management areas, no treatments may occur in those areas and that aerial treatments in high density flat-tailed horned lizard habitat elsewhere should be restricted to the fall and winter months to the extent possible. The decision of the BLM California State Director (March 6, 1997) in authorizing a beet leafhopper malathion control program on public lands in California includes the following terms and conditions:

"2. All treatment within flat-tailed horned lizard habitat shall be by aerial means only and shall be limited to only one treatment in a given area per year. Program personnel shall not use off-road vehicles in flat-tailed horned lizard habitat, except on designated roads. Treatments within areas designated by BLM as high density flat-tailed horned lizard habitat shall be conducted during the fall and winter months to the maximum extent practicable.

Figure 2. Requested beet leafhopper malathion treatment area within range of flat-tailed horned lizard (from Calif. Dept. of Food and Agric. 1995).

3. If 'flat-tailed horned lizard management areas' are designated during the life of the permit [5 years] pursuant to the ongoing interagency effort to develop a conservation agreement for this species, no treatments shall occur in these management areas after such designations have become effective."

Exotic Plants

Many species of introduced, non-native plants occur in flat-tailed horned lizard 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 flat-tailed horned lizard and locally abundant. Sahara mustard (*Brassica tournefortii*) and Russian thistle (*Salsola kali*) 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 flat-tailed horned lizard are unknown. However, their abundance in flat-tailed horned lizard 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 flat-tailed horned lizards, which are relatively wide-bodied and active. As previously discussed (see 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 flat-tailed horned lizards.

In addition to non-native annual plants, saltcedar (*Tamarix chinensis*), a non-native perennial shrub or tree, has invaded areas of shallow groundwater in flat-tailed horned lizard habitat on the west side of West Mesa, in the Yuha Basin (Wright 1993), and

along portions of the All-American and Coachella Canals. Flat-tailed horned lizards have been recorded in saltcedar communities (Kim Nicol and Betsy Bolster, CDFG, pers. comm.), but dense stands of saltcedar are likely unsuitable for them.

Predation

The same species that have been documented as predators on other horned lizard species also prey on flat-tailed horned lizards (Pianka and Parker 1975). Duncan *et al.* (1994) reported predation by American kestrel (*Falco sparverius*), common raven (*Corvus corax*), burrowing owl (*Athene cunicularia*), loggerhead shrike (*Lanius ludovicianus*), and kit fox (*Vulpes macrotis*) in California. The greater roadrunner (*Geococcyx californianus*), thrashers (*Toxostoma* spp.) and other avian predators are also likely to prey on flat-tailed horned lizards (Bryant 1911). Muth and Fisher (1992) documented predation on flat-tailed horned lizards by round-tailed ground squirrels (*Spermophilus tereticaudus*) and possibly sidewinders (*Crotalus cerastes*). They also considered coachwhip (*Masticophis flagellum*), patch-nosed snake (*Salvadora hexalepis*), glossy snake (*Arizona elegans*), and leaf-nosed snake (*Phyllorhynchus decurtatus*) to be possible flat-tailed horned lizard predators.

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). Elevated predation may contribute to a cumulative set of adverse effects that result in population declines in some areas.

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 flat-tailed horned lizard populations.

The Arizona State Land Department is disposing of land occupied by flat-tailed horned lizards 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 flat-tailed horned lizards. The State Land Department is

currently denying land sale applications for other State land parcels in flat-tailed horned lizard habitat because these lands have not yet reached their highest potential value.

Other Activities

Various specialized projects and facilities have been proposed for desert areas that provide habitat for the flat-tailed horned lizard. As habitat is lost to these projects, populations of flat-tailed horned lizards will be reduced accordingly. An example of such a project is the Cheyenne Unit of the Arizona State Prison in the Yuma Desert. Together with the existing Cocopah Unit, the prison complex will occupy about 640 acres of former flat-tailed horned lizard habitat (Fig. 11).

Management Program

Overall Goal

MAINTAIN VIABLE POPULATIONS OF FLAT-TAILED HORNED LIZARDS FOR AT LEAST 100 YEARS.

Management Objectives

- Conserve sufficient habitat to maintain viable populations of flat-tailed horned lizards in five management areas.
- Maintain a "long-term stable" or increasing population trend in all management areas. A population that is stable over the long term exhibits no downward trend in numbers or densities of animals after the effects of natural demographic and environmental stochasticity are removed.
- Establish a research area of no less than 60,000 acres in which research related to the flat-tailed horned lizard will be conducted and encourage other research anywhere that promotes conservation of the species.
- Encourage the protection through strong conservation management of one additional management area in the Coachella Valley.
- Outside of management areas, limit the loss of habitat and effects on populations of flat-tailed horned lizards through the application of effective mitigation and compensation.
- Encourage adoption of a flat-tailed horned lizard conservation program in Mexico.

General Management Strategy

In 1994, the USFWS, BLM, BR, Department of Defense, and several other agencies signed Memorandum of Understanding (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.

It is intended that this strategy will form the basis of a conservation agreement among the cooperators for management of flat-tailed horned lizards. If the USFWS determines that the resulting conservation agreement would be effective and that listing the flat-tailed horned lizard is unnecessary, it would retain 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 flat-tailed horned lizard 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 conserving sufficient habitat to maintain several viable populations of the flat-tailed horned lizard throughout the species' range in the United States. Further research on the demography of the species will be needed to precisely define the number of lizards in a viable population and the habitat area necessary to support a viable population. In the absence of such research and analyses, this strategy recommends establishing management areas encompassing large blocks of habitat where surface disturbing and mortality causing activities are minimal.

Signatory agencies will incorporate measures in the Rangewide Strategy into their land management plans. Compliance with the National Environmental Policy Act and state counterparts will be achieved through these management plans or revisions.

Management Areas

Management areas were designed to include most flat-tailed horned lizard habitat identified as key areas in previous studies, even though the absolute densities of flat-

tailed horned lizards within the management areas are not known. To the best of our ability and with the most recent information, management areas were proposed based upon accepted principles of good preserve design (Appendix 1). The management areas have been placed where significant conflict over the special management prescriptions is not occurring and is not anticipated. The management areas include as large an area as possible, but avoid extensive, existing and predicted management conflicts (e.g., off-highway vehicle open areas, geothermal development). Conflicts which are localized in nature (e.g., sand and gravel mines, military bombing targets) may be included within some of the management areas.

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

Research Area

A Research Area (RA) is proposed in California (Fig. 6 and 10) where studies of the flat-tailed horned lizard will be encouraged and funded by the CDPR's Division of Off-Highway Motor Vehicle Recreation. The RA is about 76,700 acres in size. About 43,000 acres of the RA are owned by the State and managed as the Ocotillo Wells State Vehicle Recreation Area (OWSVRA). BLM has 20,900 acres, of which about 8,000 acres which are managed by the OWSVRA. The remaining 12,900 acres of BLM land are managed according to provisions in the California Desert Conservation Area Plan. The State has applied to BLM under the Recreation and Public Purposes Act for transfer and patenting of all 20,900 acres of BLM to the OWSVRA. The State is also actively acquiring the remaining private lands (12,800 acres) within the RA.

While the OWSVRA prohibits most surface disturbing activities, off-highway vehicle free-play, racing, and touring will continue. A comparison of flat-tailed horned lizard densities in areas with and without off-highway vehicle activity will be the subject of study. It is not yet known if these activities will preclude the maintenance of a viable population of flat-tailed horned lizards at OWSVRA.

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 Fig. 1, p. 4). Within historic times, the population in East Mesa has been effectively isolated from those to the west and south by the Salton Sea, extensive

agricultural development, canals, and highways. However, those management areas to the west (i.e., Yuha Desert, West Mesa, and Borrego Badlands) lie relatively close to one another, and some movement between management areas may occur. Planned actions provide guidance for managers to maintain sufficient habitat to provide for interchange of flat-tailed horned lizards between management areas. In this way, those naturally adjoining populations of flat-tailed horned lizards will be able to interbreed, helping to maintain genetic vigor, and natural recolonization could occur in the case of extirpation from a management area.

Other Areas

Flat-tailed horned lizard habitat outside of these management areas would receive a degree of protection through mitigation and compensation. Specifically, signatories to the conservation agreement would ensure that adverse effects of projects they authorize outside of management areas would be mitigated and that residual effects would be compensated in accordance with a standard formula. The funds obtained through compensation would be used to consolidate land ownership within the management areas, enhance habitat, or conduct research.

Mexican Habitat

Although this rangewide management strategy currently addresses habitat only in the United States, there are objectives and planned actions for establishing and maintaining contacts with appropriate agencies and personnel in Mexico to promote the conservation of flat-tailed horned lizard habitat within Mexico. Agencies that have the authority to work with Mexico, including the AGFD, CDFG, USFWS, and BLM, will be making these contacts. 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 management areas in the United States and Mexico.

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 an MA shall require justification for the necessity of the route. Designated routes shall be prioritized in terms of importance to the flat-tailed horned lizard 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 off-highway 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 rights-of-way) 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.
- Step 4 - The team shall evaluate route densities and priorities, flat-tailed horned lizard population density and trend data, flat-tailed horned lizard home range size, and habitat disturbance attributed to routes to determine the level of route closures needed to ensure viable populations of flat-tailed horned lizards. Areas within MAs that support high levels of vehicular use and that are particularly important for the flat-tailed horned lizard shall be identified as high priority areas for route closure.
- Step 5 - 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., Border Patrol access) shall be evaluated for closure except to specific, authorized users.
- Step 6 - All necessary Federal and State environmental reviews shall be completed.
- Step 7 - 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. Damaged and degraded areas within the management areas, including closed routes of travel, shall be rehabilitated using the most effective techniques known. These techniques include, but are not limited to, those discussed briefly in Appendix 8.

Inventory, Monitoring, and Research

The flat-tailed horned lizard is among the least known of the phrynosomatid lizards in the United States. Existing inventory methods based on counting scat have unknown precision and accuracy. Investigators have been unable to find and capture, then recapture individuals on a regular basis. Population trends in most areas are unknown. Long-term monitoring of habitat and populations will be continued or initiated, but new methodologies will need to be developed. It is anticipated that research funded in the Department of Defense Legacy Program being initiated in 1995 will lead to new or revised monitoring methods.

Several important aspects of the species ecology and life history are unknown or uncertain. More information on how human activities impact flat-tailed horned lizards is needed. Research into various aspects of life history, impacts of activities, and management effectiveness is proposed in this strategy. The list of proposed research topics (see Planning Action 8) and monitoring parameters (see Planning Action 9) was developed by the Workgroup and was reviewed and modified by the Conservation Team.

Inventory, monitoring, and research data collected from these efforts will be analyzed by an Interagency Coordinating Committee and considered during annual reviews. Based on this information, actions may be modified through a Management Oversight Group.

Planning Actions

The following planning actions have been developed as recommendations to management agencies to ensure that the goal of population viability within each management area is achieved. 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 Flat-tailed Horned Lizard Interagency Coordinating Committee. The Management Oversight Group will meet as necessary to review recommendations of the Interagency Coordinating Committee and may make corresponding modifications to planning actions in the Strategy.

1. Delineate and designate five flat-tailed horned lizard management areas (MAs) and one flat-tailed horned lizard research area (RA). See Table 1 (Appendix 2) 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 Flat-tailed Horned Lizard MA as shown on Figure 3 (Appendix 2). If the proposed Area Service Highway is constructed along a portion of the boundary of the MA, the east and south side of the right-of-way will be the new western and northern boundary of the MA, as appropriate.
 - 1.2 Designate the East Mesa Flat-tailed Horned Lizard MA as shown on Figure 4 and 5 (Appendix 2).
 - 1.3 Designate the West Mesa Flat-tailed Horned Lizard MA as shown on Figure 6 and 7 (Appendix 2).
 - 1.4 Designate the Yuha Desert Flat-tailed Horned Lizard MA as shown on Figure 6 and 8 (Appendix 2).
 - 1.5 Designate the Borrego Badlands Flat-tailed Horned Lizard MA as shown on Figure 6 and 9 (Appendix 2).
 - 1.6 Designate the area shown in Figure 6 and 10 (Appendix 2) in and around the Ocotillo Wells SVRA as the Ocotillo Wells Flat-tailed Horned Lizard Research Area (RA).
 - 1.7. Encourage the development of one additional flat-tailed horned lizard MA in the Coachella Valley by working with other agencies and organizations in developing a Coachella Valley Multi-species Plan that incorporates a

management area capable of sustaining a viable population of flat-tailed horned lizards.

2. Define and implement management actions necessary to minimize loss or degradation of habitat.
 - 2.1 Mitigate and compensate, as needed, project impacts on flat-tailed horned lizard and its habitat both within and outside of MAs and the RA through humane and cost-effective measures.
 - 2.1.1 Apply mitigation measures in Appendix 3, as appropriate, based on the nature of the anticipated impacts.
 - 2.1.2 In accordance with Appendix 4, require compensation for residual impacts remaining after application of other mitigation measures.
 - 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 flat-tailed horned lizards and their habitat. Every attempt shall be made to locate projects outside of MAs. New rights-of-way may be permitted only along the boundaries of MAs and only if impacts can be mitigated to avoid long-term effects on populations of flat-tailed horned lizards 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 Interagency Coordinating Committee and the Management Oversight Group shall be contacted to provide suggestions for minimizing potential impacts to flat-tailed horned lizards. The cumulative new disturbance per MA may not exceed 1 percent of the total acreage. 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 rights-of-way facilities may continue within MAs.
- 2.2.4 The proposed Area Service Highway is 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 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 and compensation (Appendices 3 and 4, respectively).
- 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 "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.
- 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. Border Patrol to ensure cooperation with and enforcement of vehicle regulations in MAs and the RA to the maximum extent possible.
- 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 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 flat-tailed horned lizard 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 non-motorized recreational activities, such as rockhounding, hiking, backpacking, non-vehicle based camping, picnicking, bicycling, horseback-riding, hunting, birdwatching, 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. 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 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.
- 2.7 Within the MAs, allow off-road military maneuvers and encampments only in designated sites. Allow other military activities on previously disturbed lands managed by Department of Defense agencies consistent with normal operations and functions. Marine Corps activities on the Barry M. Goldwater Range shall be governed by Conference Opinion 2-21-95-F-114, dated April 17, 1996 (USFWS 1996) whether the species is listed or not. This conference opinion is consistent with the strategy set forth in this document.
- 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, 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.
- 2.10 Within an MA, other discretionary land uses and activities not consistent or compatible with the above restrictions and the general management strategy 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. These techniques are described briefly in Appendix 8.
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 Management Oversight Group (see Plan 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 flat-tailed horned lizards 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. In addition, activities in the Yuha Desert and Yuma Desert MAs that would prevent interchange of flat-tailed horned lizards across the International Border shall be prohibited.
 - 5.2 Coordinate conservation efforts with Mexico and Immigration and Naturalization Service to ensure continued movement of flat-tailed horned lizards 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 Establish a Flat-tailed Horned Lizard Management Oversight Group (FTHL MOG) consisting of management representatives from agencies participating in the conservation agreement (see Planned Action 6.2). The

FTHL MOG shall provide management-level leadership, coordination, and oversight in the implementation of this Management Strategy. The FTHL MOG shall review progress in implementing the conservation agreement, approve amendments to the Strategy, set priorities, and recommend measures to resolve management issues relevant to implementation of the Management Strategy. 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 Interagency Coordinating Committee (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 flat-tailed horned lizard 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 development of a flat-tailed horned lizard conservation program in Mexico.
- 6.2 Confirm commitment of agencies participating in this Management Strategy through development and signing of a conservation agreement.
- 6.3 Incorporate management actions from this Strategy when developing multi-agency, multi-species ecosystem plans for the ecoregions in the range of the flat-tailed horned lizard incorporating management actions from this Strategy.
 - 6.3.1 Incorporate actions in the development of the Western Colorado Desert Coordinated Management Plan (including the Yuha Desert, West Mesa, East Mesa, Borrego Badlands MAs and Ocotillo Wells RA).
 - 6.3.2 Incorporate actions in the development of the Coachella Valley Multi-species Plan (including proposed Coachella Valley MA.)

- 6.4 Coordinate with the Border Patrol in developing mutual agreements for the conservation of natural resources.

- 7. Promote the purposes of the strategy through law enforcement and public education.
 - 7.1 Provide law enforcement in MAs sufficient to ensure compliance with off-highway vehicle 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 and RA and shall list all pertinent regulations.

- 8. Encourage and support research that will promote the conservation of flat-tailed horned lizards or desert ecosystems and will effectively define and implement necessary management actions, both within and outside of MAs and the RA. Planned actions 8.3 and 8.4 shall be emphasized, as recommended by the Conservation Team.
 - 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.
 - 8.2 The Ocotillo Wells SVRA shall continue to budget for research for at least 5 years. Research designs will be recommended by a team of scientists and managers. Results shall be distributed to other land management agencies.
 - 8.3 Develop a cost-effective technique for assessing flat-tailed horned lizard abundance.
 - 8.3.1 Test trapping and other techniques (e.g., pit fall traps, minnow traps, drift fences, funnel traps, road surveys, walking surveys, and detection by dogs) to enumerate flat-tailed horned lizards directly.
 - 8.3.2 Determine effectiveness of direct enumeration techniques and scat counts 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 flat-tailed horned lizard demographics and habitat:
 - Paved roads and highways
 - Off-highway vehicle use and associated activities
 - Geothermal development
 - Pesticide Use
 - Predation
 - Non-native plants
 - Fire

- 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 mitigation measures described in Appendix 3.

- 9.0 Continue inventory and monitoring.

- 9.1 Continue to inventory lands within the range of flat-tailed horned lizards.

- 9.2 Monitor habitat quality and population trends in five MAs to determine progress toward overall management goal.
- 9.2.1 The ICC shall monitor implementation of the strategy and/or resulting conservation agreement.
- 9.2.2 Land management agencies shall monitor regional population trends using standardized techniques to be developed (see Planned Action 8.3).
- 9.2.3 Land management agencies shall document habitat disturbance and loss.
- 9.2.4 The ICC shall prepare an annual report of monitoring results and progress on implementation.
- 9.2.5 New inventory, monitoring, and research data shall be used in evaluations of the Management Strategy and in assessing proposed changes to the Management Strategy. Solicit and consider input from affected agencies and the public before incorporating any such modifications.

Implementation

Priorities, Estimated Costs, Schedule

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.

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 are used in the implementation table for the responsible parties:

ABDSP	= Anza-Borrego Desert State Park
AGFD	= Arizona Game and Fish Department
BLM	= Bureau of Land Management
BR	= 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

Flat-tailed Horned Lizard Strategy Implementation Schedule

Priority number	Action number	Planned action	Duration (yrs)	Resp. agency	Total cost (\$000)	Cost estimates (\$000)				
						FY 1998	FY 1999	FY 2000	FY 2001	FY 2002
1. Delineate and designate flat-tailed horned lizard management areas.										
1	1.1	Designate Yuma Desert MA	2	BLM BR USMC	8	4				
1	1.2	Designate East Mesa MA	2	BLM USN	8	4	4			
1	1.3	Designate West Mesa MA	2	BLM USN	8	4	4			
1	1.4	Designate Yuha Desert MA	2	BLM	8	4	4			
1	1.5	Designate Borrego Badlands MA	2	ABDSP	4	2	2			
3	1.6	Designate Ocotillo Wells RA	1	BLM OWSVRA ABDSP	8	4	4			
3	1.7	Encourage MA in Coachella Valley	1	BLM USFWS CDFG	0					
2. Define and implement actions necessary to minimize loss or degradation of habitat.										
1	2.1.1	Apply mitigation measures	on-going	All	0					
1	2.1.2	Require compensation	on-going	All	15	3	3	3	3	3

1	2.2.1	Limit discretionary land uses authorizations and ROWs to 10 acres and 1% total per MA	on-going	All	0
1	2.2.2	Do not dispose of lands in MAs	on-going	All	0

(continued)

Flat-tailed Horned Lizard Rangewide Management Strategy

Flat-tailed Horned Lizard Strategy Implementation Schedule (continued).

Priority number	Action number	Planned action	Duration (yrs)	Resp. agency	Total cost (\$000)	Cost estimates (\$000)				
						FY 1998	FY 1999	FY 2000	FY 2001	FY 2002
3	2.2.3	Maintenance in existing ROWs may continue	on-going	All	0					
2	2.2.4	Require fencing along Yuma MA boundary road								
2	2.3.1	Limit surface disturbance from mineral activities in MAs	on-going	All	0					
2	2.4.1	Reduce new roads to a minimum in MAs	2	All	0					
1	2.4.2	Designate routes "open," "closed, or limited." Give route signing a priority.	2/on-going	BLM	180	40	80	20	20	20
1	2.4.3	Reduce route density in MAs	See 2.4.2							
1	2.4.4	Coordinate with U. S. Border Patrol	on-going	BLM BR USN USMC OWSVRA ABDSP	20	4	4	4	4	4
3	2.5.1	Vehicle-oriented recreation allowed in RA	on-going	BLM OWSVRA	0					
1	2.5.2	No competitive recreational events in MAs	on-going	All	0					
2	2.5.3	Non-motorized recreational activities allowed in MAs, but no new recreational facilities	on-going	All	0					
2	2.5.4	Limit camping in MAs	2/on-going	BLM	20	10	10			
2	2.5.5	No new long-term visitor areas in MAs	on-going	All	0					

3	2.6	Do not sell plant products in MAs	on-going	All	0
1	2.7	Allow military maneuvers and encampments only in designated sites in MAs	on-going	USN USMC	0

(continued)

Flat-tailed Horned Lizard Rangewide Management Strategy

Flat-tailed Horned Lizard Strategy Implementation Schedule (continued).

Priority number	Action number	Planned action	Duration (yrs)	Resp. agency	Total cost (\$000)	Cost estimates (\$000)				
						FY 1998	FY 1999	FY 2000	FY 2001	FY 2002
3	2.8	Suppress fires in MAs using limited fire suppression methods in MAs	on-going	All	0					
1	2.9	Prohibit pesticide treatments in MAs	on-going	All	0					
3	2.10	Limit other activities consistent with above	on-going	All	0					
3. Rehabilitate damaged and degraded habitat.										
2	3	Rehabilitate damaged and degraded habitat in MAs	on-going	BLM BR ABDSP USMC USN	200	40	40	40	40	40
4. Bring all lands within management areas into public management.										
3	4.1	Maintain prioritized list of parcels for acquisitions; and respect private rights	1	All	0					
3	4.2	Seek funds for land acquisitions in MAs (37,600 acres of private lands acres in California MAs and 15,500 acres of State Land Department lands in Yuma Desert MA at \$250 per acre)	on-going	All	15,900					

(continued)

Flat-tailed Horned Lizard Rangewide Management Strategy

Flat-tailed Horned Lizard Strategy Implementation Schedule (continued).

Priority number	Action number	Planned action	Duration (yrs)	Resp. agency	Total cost (\$000)	Cost estimates (\$000)				
						FY 1998	FY 1999	FY 2000	FY 2001	FY 2002
3	4.3	Use compensation funds to acquire key lands in MAs	on-going	BLM AGFD CDFG ABDSP OWSVRA	20	4	4	4	4	4
3	4.4	Exchange lands opportunistically	on-going	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	on-going	All	25	5	5	5	5	5
3	5.2	Coordinate with Mexico and INS	on-going	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	on-going	All	20	4	4	4	4	4
2	6.1.2	Hold semi-annual ICC meetings	on-going	All	5	1	1	1	1	1
3	6.1.3	Establish forum for discussions with agencies and individuals in Mexico	on-going	All	5	1	1	1	1	1
1	6.2	Develop Conservation Agreement	1	All	4 ¹					

1 Cooperative Agreement to be developed and signed in 1997.

(continued)

Flat-tailed Horned Lizard Rangewide Management Strategy

Flat-tailed Horned Lizard Strategy Implementation Schedule (continued).

Priority number	Action number	Planned action	Duration (yrs)	Resp. agency	Total cost (\$000)	Cost estimates (\$000)				
						FY 1998	FY 1999	FY 2000	FY 2001	FY 2002
2	6.3.1	Incorporate actions in Western Colorado Desert ecosystem plan (Note: other state and local agencies will fill key roles)	3	BLM CDFG OWSVRA ABDSP USFWS USN	750	20	300	250	200	
2	6.3.2	Incorporate actions in Coachella Valley Multi-species Plan (Note: other state and local agencies will fill key roles)	3	BLM CDFG USFWS	600	300	200	100		
1	6.4	Coordinate with U. S. Border Patrol and develop mutual agreements	2	BLM BR	6	3	3			
7. Promote the purposes of the strategy through law enforcement and public education.										
1	7.1	Provide adequate law enforcement	on-going	BLM CDFG AGFD	750	150	150	150	150	150
3	7.2	Provide public information and education	on-going	All	25	5	5	5	5	5
8. Conduct research necessary to effectively define and implement necessary management actions.										
8						(schedules to be determined)				

3	8.1	Require permits for research	on-going	All	5	1	1	1	1	1
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(continued)

Flat-tailed Horned Lizard Rangewide Management Strategy

Flat-tailed Horned Lizard Strategy Implementation Schedule (continued).

Priority number	Action number	Planned action	Duration (yrs)	Resp. agency	Total cost (\$000)	Cost estimates (\$000)				
						FY 1998	FY 1999	FY 2000	FY 2001	FY 2002
2	8.2	Ocotillo Wells SVRA shall continue to fund research	on-going	OWSVRA	200 ¹	40	40	40		
2	8.3.1	Test trapping as a population census technique	2	OWSVRA USMC	170 ²					
2	8.3.2	Test direct counting methods	2	OWSVRA USMC		Included in 8.2 and 8.3. 1				
2	8.4	Determine life history and demographic data	2	USMC OWSVRA	100	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					

1 Funding for 5-year study began in 1996.

2 Funding for multi-year study provided in 1996.

(continued)

Flat-tailed Horned Lizard Strategy Implementation Schedule (continued).

Priority number	Action number	Planned action	Duration (yrs)	Resp. agency	Total cost (\$000)	Cost estimates (\$000)				
						FY 1998	FY 1999	FY 2000	FY 2001	FY 2002
9. Continue inventory and monitoring.										
2	9.1	Continue inventories	on-going	BLM OWSVRA ABDSP USFWS AGFD CDFG	125	25	25	25	25	25
2	9.2.1	Monitor implementation	on-going	ICC	40	8	8	8	8	8
2	9.2.2	Monitor population trends	on-going	BLM OWSVRA ABDSP	200	0	50	50	50	50
1	9.2.3	Document habitat disturbance and loss	on-going	BLM OWSVRA ABDSP	40	8	8	8	8	8
2	9.2.4	Prepare annual monitoring/ implementation report	on-going	ICC	20	4	4	4	4	4
1	9.2.5	Use new inventory, monitoring, and research data in evaluations and proposed changes	on-going	All	0					

(End of Table)

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APPENDIX 1

Principles of Good Preserve Design

The following principles of reserve design are taken from Noss and Cooperrider (1994). They presented the list with the following introduction:

In their conservation strategy for the northern spotted owl, Thomas *et al.* (1990) listed five reserve design concepts that they characterized as 'widely accepted among specialists in the fields of ecology and conservation biology.' We agree, and paraphrase these guidelines below, adding a sixth (from Noss 1992) that applies to species that are especially sensitive to human disturbance and, therefore, greatly in need of protection.

1. Species well distributed across their native range are less susceptible to extinction than species confined to small portions of their range.
2. Large blocks of habitat containing large populations of a target species are superior to small blocks of habitat containing small populations.
3. Blocks of habitat close together are better than blocks far apart.
4. Habitat in contiguous blocks is better than fragmented blocks.
5. Interconnected blocks of habitat are better than isolated blocks, and dispersing individuals travel more easily through habitat resembling that preferred by the species in question.
6. Blocks of habitat that are roadless or otherwise inaccessible to humans are better than roaded and accessible habitat blocks.

APPENDIX 2

Tables and Figures Describing Management Areas

Table 1. Sizes (acres) and ownership of proposed flat-tailed horned lizard management areas.

Management Area ¹	Federal Non-military ²	Federal Military	State ³	Private	TOTAL
Yuma Desert ⁶	16,200	99,300 ⁴	15,500 ⁵		131,000
East Mesa	99,900	8,500		6,900	115,300
West Mesa	83,200	29,800	1,300	21,800	136,100
Yuha Basin	57,200			3,000	60,200
Borrego Badlands			36,500	5,900	42,400
TOTAL	256,300	138,100	53,200	37,600	485,200

1. The existing Coachella Valley Preserve includes about 17,076 acres administered by Federal and State agencies and private organizations.
2. Includes lands administered by the BLM and BR.
3. Includes lands administered by CDPR, California State Lands Commission, and Arizona State Land Department.
4. Lands administered by U. S. Marine Corps and BLM.
5. State lands administered by Arizona State Land Department. It is expected that these lands will not be managed under this Strategy.
6. A portion of the Yuma Desert MA boundary will be formed by the proposed Area Service Highway, if and when constructed.

List of Figures Showing Management Areas

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Figure 10	Page 72	Ocotillo Wells Research Area.
Figure 11	Page 73	Bureau of Reclamation lands in Yuma Desert Management Area.

On the following pages, Figures 3, 4, and 6 show the general location of the MAs and RA. Figures 5, 7, 8, 9, and 10 are included to show more detailed land ownership and to show routes of travel in California. Some of these routes are closed to use. Land ownership may not reflect the most recent acquisitions, especially in the Ocotillo Wells RA and the Borrego Badlands MA where the California Department of Parks and Recreation has been actively acquiring lands. Map 11 is included to show details of Bureau of Reclamation lands in Arizona. Note that the map scales vary greatly.

Figure 3. Map of proposed Yuma Desert Flat-tailed Horned Lizard Management Area.
(One inch equals 4.8 miles; Mapscale about 1:300,000)

Figure 4. Map of proposed East Mesa Flat-tailed Horned Lizard Management Area.

Figure 5. East Mesa Management Area (Detail).

Figure 6. Map of proposed Yuha Desert, West Mesa, and Borrego Badlands Flat-tailed Horned Lizard Management Areas and proposed Ocotillo Wells Research Area.

Figure 7. West Mesa Management Area (Detail)

Figure 8. Yuha Desert Management Area (Detail)

Figure 9. Borrego Badlands Management Area (Detail)

Figure 10. Ocotillo Wells Research Area (Detail)

Figure 11. Yuma Desert Management Area (Detail of BOR Lands)

APPENDIX 3

List of Standard Mitigation Measures for Flat-tailed Horned Lizard

The following mitigation measures are to be incorporated into all surface-disturbing projects where applicable. The measures are to be modified to conform with the nature of the project.

1. Within flat-tailed horned lizard management areas and the research area, construction in areas unsuitable for burrowing by flat-tailed horned lizards shall be limited to the dormant period (November 15 through February 15) for the flat-tailed horned lizard.
2. A worker education program shall be developed and implemented. 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 flat-tailed horned lizard,
 - protection measures designed to reduce potential impacts to the species,
 - function of flagging designating authorized work areas,
 - reporting procedures to be used if a flat-tailed horned lizard is encountered in the field, and
 - importance of exercising care when commuting to and from the project area to reduce mortality of flat-tailed horned lizards on roads.
3. To the extent possible, surface-disturbing projects shall be located outside of flat-tailed horned lizard management areas and the research area. If a project must be located within a management area or the research area, 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.
4. Prior to project initiation, an individual shall be designated as a field contact representative (FCR). The FCR shall have the authority to ensure compliance with protective measures for the flat-tailed horned lizard and will be the primary agency contact dealing with these measures. The FCR shall have the authority and responsibility to halt activities that are in violation of these terms and conditions.

5. 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 which have been flagged to eliminate adverse impacts to the flat-tailed horned lizard and its habitat. All workers shall be instructed that their activities are restricted to flagged and cleared areas.
6. Within MAs [or outside MAs if judged necessary], a biological monitor shall be present in each area of active construction throughout the work day from initial clearing through habitat restoration, except where the project is completely fenced and cleared of horned lizards by a biologist (see Measure 13). The biological monitors shall have sufficient education and field experience or training with the flat-tailed horned lizard to understand its biology and behavior. The monitor(s) shall perform the following functions:
 - a. Ensure that all project-related activities are in compliance with these measures. The biological monitor shall have the authority and responsibility to halt activities that are in violation of these terms and conditions.
 - b. Examine construction areas periodically (at least hourly when surface temperatures exceed 30° C) for the presence of flat-tailed horned lizards. In addition, all hazardous sites (e.g., open pipeline trenches, holes, or other deep excavations) shall be inspected for the presence of flat-tailed horned lizards prior to backfilling.
 - c. Work with the construction supervisor to take steps, as necessary, to avoid disturbance to flat-tailed horned lizards and their habitat. If avoiding disturbance to a flat-tailed horned lizard is not possible or if a flat-tailed horned lizard is found trapped in an excavation, the affected lizard shall be captured by hand and relocated.
7. Only persons authorized by the California Department of Fish and Game [California] or the Arizona Game and Fish Department [Arizona] shall be permitted to handle flat-tailed horned lizards.
8. If surveys are required, they must be conducted as specified in the interim survey protocol (Appendix 7) or an alternative subsequently approved by the Management Oversight Group.
9. Relocated flat-tailed horned lizards shall be placed in the shade of a large shrub a short distance from the construction zone and in the direction of undisturbed habitat. If surface temperatures in the sun are less than 30° C or exceed 50° C, the biologist or FCR, if authorized to handle, shall hold the flat-tailed horned lizard for later release. Initially,

captured flat-tailed horned lizards shall be held in a cloth bag, cooler, or other appropriate clean, dry container from which the lizard cannot escape. Lizards shall be held at temperatures between 25 and 35° C and shall not be exposed to direct sunlight. Release shall occur as soon as possible after capture and during daylight hours when surface temperatures range from 32 to 40° C. If such conditions do not occur within 48 hours of capture, the lizard shall be transferred to a terrarium containing at least 2 inches of sand from the project area. The terrarium shall be maintained at 10 to 20° C until conditions at the site are appropriate for release. Lizards shall be allowed to acclimate to higher surface temperatures prior to release. The biologist shall be allowed some judgement and discretion to ensure that survival of flat-tailed horned lizards found in the project area is likely.

10. Within flat-tailed horned lizard 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 right-of-way, 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.
11. Existing roads shall be used for travel and equipment storage whenever possible.
12. Where feasible and desirable, in the judgement 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, maintenance of access control structures and facilities shall be maintained by the project proponent for the life of the project and until habitat restoration is completed, including monitoring.
13. Sites of permanent or long-term projects in MAs where continuing activities are planned and where flat-tailed horned lizard mortality could occur shall be enclosed with flat-tailed horned lizard barrier fencing to prevent lizards from wandering onto the project site where they may be subject to collection, death, or injury. Barrier fencing should consist of 0.5-inch wire mesh fastened securely to posts. The wire mesh should extend at least 12 inches above the ground and 12 inches below the surface of the ground. Any gates or gaps in the fence should be constructed to prevent lizard entry. After clearing the area of horned lizards, no on-site monitor is required (see Measure 6).

14. A project-specific habitat restoration plan shall be developed by the project proponent 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. Generally, the restoration objective shall be to return the disturbed area to a condition that will perpetuate previous land use. Periodic inspection of the restored area shall be conducted by the project proponent. Restoration shall include eliminating any hazards to flat-tailed horned lizards 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.

APPENDIX 4

Compensation Formula

Compensation shall be required to offset the residual effects of projects affecting flat-tailed horned lizard habitat. Residual effects are those that remain after all reasonable on-site mitigation measures are incorporated into a project. The goal of compensation is to make a project's net effect neutral or positive to the flat-tailed horned lizard. If the adverse effects of an action can be fully mitigated (no net adverse impact) or if an action would result in no adverse effects on habitat, then compensation is not required. Adverse residual effects to habitat shall be compensated through acquisition of habitat within an MA or contribution to a compensation fund that will be used to acquire lands and enhance habitat in MAs. Funds shall not be used for law enforcement or monitoring. Priorities for use of compensation funds shall be determined by the Flat-tailed Horned Lizard Management Oversight Group (FTHL MOG).

The compensation formula to be applied for disturbance of habitat within a management area is presented in this appendix. The multiplying factor (M) is multiplied by the number of acres disturbed to arrive at the compensation acreage. If the land to be disturbed is within a management area, the multiplying factor will range from 3 to 6. Outside of the management areas, but within occupied habitat as determined according to the survey protocol (see Appendix 7), the multiplication factor shall be 1. Compensation shall not be required for disturbance of areas that clearly do not support the species or desert scrub communities, such as agricultural and urban areas. A detailed description of how to evaluate each factor may be found in "Compensation for the Desert Tortoise" (Desert Tortoise Compensation Team, 1991).

Signatories to the Flat-tailed Horned Lizard Conservation Agreement will not be required to compensate for the conservation activities defined on pages 43-48 of the Management Strategy. In addition, the establishment of the MAs with a 1 percent cap (Planning Action 2.2.1) on new surface disturbance represents compensation for agency activities that may disturb flat-tailed horned lizard habitat while limiting the activities of signatory agencies on their lands. The 1 percent cap on new surface disturbance within MAs will remain in effect for 5 years, after which the 1 percent 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 percent of the land that the agency manages within the MA. Additions to the 242 Well Field by the Bureau of Reclamation and existing, on-going activities at Department of Defense facilities (for the Marine Corps Base - Yuma, these activities are described in the EIS for the Yuma Training

Range Complex) do not count towards this 1 percent. If disturbance greater than the 1 percent cap is desired, the agency may request use of the 1 percent disturbance allowance of other signatory agencies in the MA. All surface disturbance within each MA must be reported to the ICC, which will report to the MOG. Federal agencies will comply with the National Environmental Policy Act and the Council on Environmental Quality guidelines in regards to any further compensation. State agencies will follow procedures in their respective environmental laws, if any. If compensation beyond the level of contribution by an agency to an MA is necessary, the agency shall use the compensation formula to determine the amount of compensation. Compensation funds shall be targeted for habitat acquisition and enhancement in California and for habitat acquisition and accelerated implementation of management actions in Arizona.

If it is desirable or necessary to convert the compensation acreage to a monetary equivalent, the fee is multiplied by the estimated cost to purchase land. Each agency may develop its own estimate of land cost in accordance with standard policies and procedures. 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 management area. 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 Bureau of Land Management shall act as a clearinghouse for compensation funds and accounting data.

The multiplying factor (M) is computed as follows:

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

where the factors are evaluated as shown below:

C	Classification of habitat:	
	a) The lands disturbed are in a management area.	3
	b) The lands disturbed are outside a management area but within existing flat-tailed horned lizard habitat as determined by methods in Appendix 7. (Do not add the following factors.)	1
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

APPENDIX 5

List of Participants

Flat-tailed Horned Lizard Rangewide Strategy Working Group

Primary Workgroup participants are indicated by an "*" . Others participated in one or more meetings, contributed written material, or provided review comments:

David Amme	California Department of Parks and Recreation, Off-Highway Motorized Vehicle Recreation Division (OHMVRD), Sacramento, California
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Major Joe Cox	United States Marine Corps Air Station, Range Management Department, Yuma, Arizona
*John Crow	United States Navy, El Centro Naval Air Facility, Public Works Department, El Centro, California
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Linden Piest	Arizona Game and Fish Department, Yuma, Arizona
Robert Powell	County of Imperial, Agricultural Commission, El Centro, California
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*Brenda Smith	Bureau of Land Management, Yuma Field Office, Yuma, Arizona
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Gavin Wright

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APPENDIX 6

Flat-tailed Horned Lizard Conservation Team - Role and Participants

Role in the Development of the Rangewide Management Strategy

The Flat-tailed Horned Lizard Conservation Team was formed as an advisory group to the Rangewide Strategy Working Group. The purpose of the Team was to ensure that the Strategy was based upon the best biological information available. The Team included most investigators who have conducted significant research on the species since 1978. The Team also included other experts in lizard ecology, herpetology, and conservation biology. The Team was charged with carrying out the following tasks:

1. Evaluate the need for and usefulness of conducting a population viability analysis for the flat-tailed horned lizard,
2. Prepare a population viability analysis, if appropriate,
3. Identify research needed to ensure effective conservation of the flat-tailed horned lizard,
4. Identify monitoring activities and protocols needed to guide and document implementation of the Rangewide Strategy.
5. Assist the Rangewide Strategy Working Group in the application of the principles of conservation biology to size and number of management areas and management needs within the management areas, and
6. Review and provide comments to the Working Group on drafts of the Rangewide Management Strategy.

In response to these tasks, the Team reviewed and commented on several drafts of the Rangewide Management Strategy, developed research priorities (see planning action 8), developed an interim survey protocol (Appendix 7), and prepared a population viability

analysis ("Flat-tailed Horned Lizard, *Phrynosoma mcalli*, Population Viability Analysis: Implications for Conservation Strategies and Research Priorities").

Participants

Wendy Hodges	Department of Zoology, University of Texas, Austin, Texas
Mark Fisher	University of California, Deep Canyon Desert Research Center, Palm Desert, California
Andy Holycross	Zoology Department, Arizona State University, Tempe, Arizona
Jeff Howland	Arizona Game and Fish Department, Non-Game Branch, Phoenix, Arizona
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Frederick Turner	Santa Monica, California
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Laurie Vitt	Department of Zoology, University of Oklahoma, Norman, Oklahoma

APPENDIX 7

Flat-tailed Horned Lizard Interim Survey Protocol

Introduction

Several different methods have been developed and used beginning in 1979 to determine relative abundance of the flat-tailed horned lizard. These methods have involved counting horned lizard scat and/or flat-tailed horned lizards during walking surveys (Turner and Medica 1982, Rorabaugh *et al.* 1987, BLM and CDFG 1990, Wone *et al.* 1991). All of these methods assume a correlation between relative abundance and scat and/or lizard counts; however, limited data exist to test this assumption. Research is currently underway on the Goldwater Range in Arizona to more rigorously test scat counts and other methods for determining relative abundance. Until that research is complete, the following interim survey protocol should be used. The objective of this protocol is to provide an assessment of flat-tailed horned lizard presence or absence at specific sites. Absence cannot be confirmed with this protocol, but for planning purposes negative survey results provide reasonable assurance that the species is not present. If the results indicate the species is present in a proposed project area, that project should be subject to appropriate mitigation and compensation.

Areas of Known Occurrence

Based on flat-tailed horned lizard locality records, resource and land management agencies should map areas of known flat-tailed horned lizard occurrence. In these areas, if major habitat alteration or conversion has not taken place since the species was detected, assume it is present.

Areas of Unknown Occurrence

Resource and land management agencies should map areas in which the presence of the species is in question. These areas would include potentially suitable habitat within or on the edge of the species' range in which the species is undocumented. Where the presence or absence of the flat-tailed horned lizard needs to be determined, the following surveys shall be conducted:

Scat and Horned Lizard Surveys

Walking surveys shall be conducted, including separate surveys for horned lizard scat and horned lizards. Transects shall consist of parallel, linear routes evenly-spaced across the survey area. Each route shall be traversed by a single worker. Scat and lizard survey routes shall be alternated. During surveys for scat, workers should focus on finding scat within a swath approximately 1.3 meters (50 inches) in width (but scat observed outside of the 1.3 meter transect swath shall also be noted). Scat between 5.5 and 10 mm in diameter that contain predominantly ant parts shall be considered horned lizard scat.

In large-scale survey efforts involving walking surveys, flat-tailed horned lizard encounter rates have averaged about one lizard per 10 hours of survey time (Hodges 1995, Wright 1993, Wone *et al.* 1991, Rorabaugh *et al.* 1987, Turner and Medica 1982). Thus, to provide a reasonable chance of finding a flat-tailed horned lizard, a minimum of 10 hours of survey effort shall be expended in each section (640 acres) surveyed. Survey effort in portions of sections shall be reduced proportionally (i.e., five hours of surveys in a half section). However, in areas of less than 247 acres (1 km²), no less than four hours of surveys shall be conducted.

Although investigators shall focus on finding either horned lizard scat or horned lizards, both scat and horned lizards shall be noted during either type of survey. All surveys shall be conducted from April through September. Lizard surveys shall be conducted when surface temperatures in the sun range from 35 to 50°C. Scat surveys shall not be conducted for at least 12 days after heavy rains, hailstorms, or strong winds of an intensity sufficient to move considerable amounts of sand across roads or that damage signs and trees.

Road Surveys

Flat-tailed horned lizards 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 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 substrate temperatures adjacent to the road and in the sun range from 35 to 50°C.

Data Records

The location of transects, and each flat-tailed horned lizard, 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.

Required Authorizations and Qualifications

Only persons authorized by Arizona Game and Fish Department (in Arizona) or California Department of Fish and Game (in California) shall handle flat-tailed horned lizards. Only qualified investigators shall conduct walking surveys. Investigators shall have documented training and experience in surveying for flat-tailed horned lizards and their scat, or shall obtain training from an experienced investigator. Training for workers conducting scat counts shall consist of conducting surveys in the field for at least one full workday with an experienced investigator and demonstrating competency by counting at least 90 percent of the scat counted by the experienced investigator on a transect on which the trainee walks in front of the experienced investigator and on which at least 20 scat are observed by the experienced investigator. Investigators shall also be trained to distinguish flat-tailed horned lizards from desert horned lizards. Prior to any survey effort, a survey proposal shall be developed and approved by Arizona Game and Fish Department (in Arizona), California Department of Fish and Game (in California), and/or by the State or Federal agency that manages the lands to be surveyed.

Interpretation of Survey Results

The following criteria shall be used to derive presence or absence of the flat-tailed horned lizard from the survey results:

- Species present if:
1. Flat-tailed horned lizards are found; or
 2. Horned lizard scat is found and the desert horned lizard is unlikely to occur at the project site; or
 3. Flat-tailed horned lizards have been found within two miles and the habitat is suitable and continuous between the project site and the site of the locality record.

- Species absent if:
1. No scat or horned lizards are found; and
 - a. No flat-tailed horned lizards have been found within two miles of the project site; or
 - b. Flat-tailed horned lizard locality record(s) exist within two miles, but the habitat is not continuous or suitable between the locality and project set; or
 2. Scat is found, no flat-tailed horned are found, but desert horned lizards occur or are likely to occur, and
 - a. No flat-tailed horned lizard locality record(s) exist within two miles of the project site, or
 - b. Flat-tailed horned lizard locality record(s) exist within two miles, but the habitat is not continuous or suitable between the locality and project set.

If, based on the above analysis, flat-tailed horned lizards are deemed present, locality records, scat occurrence, and descriptions of habitat shall be used to delineate the extent of occupied habitat.

FLAT-TAILED HORNED LIZARD/SCAT TRANSECT RECORD

Project name: _____ Observer (complete name): _____

Transect type (circle): Lizard Scat Road Transect number: _____

Location: Quad _____ T _____ R _____ Sec _____

Date (mm/dd/yy): _____

Time (using 24-hour clock): Daylight time: no yes

Start time (hhmm): _____ End time (hhmm): _____

Total survey time (search time only) _____ min.

Surface temperature: °C °F (circle) Start: _____ End: _____

Cloud cover (%): Start: _____ End: _____

Dominant perennial plant species (sci. name): _____

Dominant annual plant species (sci. name): _____

Substrate (circle): clay silt sand gravel rock desert-pavement other _____

Disturbance (circle): road veh-tracks veg-clearing structure other _____

Flat-tailed Horned Lizards Observed

Sex (M/F)	SVL (mm)	Weight (g)	Surf. Temp. (°C/°F)	Time (hhmm)	Notes

Number of scat observed: _____

TOTAL No. _____

Number of scat observed outside 1.3-m swath: _____

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Number of *P. platyrhinos* observed: _____

Comments: _____

APPENDIX 8

Overview of Techniques for Rehabilitation of Lands in Flat-tailed Horned Lizard Management Areas

The measures described below are intended to speed the rebuilding of soil structure and the restoration of the native flora and fauna. The techniques described below are not exhaustive. It is expected that new techniques will be developed, and the techniques described will be refined. For a summary of available literature, see Lovich (1993).

Alleviating soil compaction improves water infiltration and allows for plant root growth. Current methods for rehabilitating closed routes include ripping and scarifying compacted surfaces using farming implements such as tillers and disks pulled by tractors.

After the compacted surface is broken up, other implements can be used to smooth the rough surface and return it to its original contour. Among the equipment used are drag harrows with either spike-tines and flex-tines or link-chain harrows. Road berms may need to be broken up and leveled to visually eliminate the roadbed and to allow natural drainage of the area. Pitting or imprinting implements that can be pulled by a pickup truck or a tractor may also be used. A pitted soil surface allows plants to become more easily established by providing small areas where seeds and rainwater can be captured.

Planting native shrubs and/or seeding native plants to the prepared area may facilitate restoration. However, restoration in desert scrub communities is often unsuccessful, and restoration techniques are not well-studied in the very arid regions of the Sonoran Desert, where flat-tailed horned lizards occur (Bauder and Larigauderie 1991). Restoration at route intersections is especially important to discourage vehicle use. Planted seedlings also provide a barrier to traffic because plants will usually need to be protected by wire mesh cages for the first year.

When planting seedlings, a critical element of survival is the amount of root biomass the plant has when it is planted. The root biomass will keep the plant alive during the long hot summer. Some slow growing species, such as creosote bush (*Larrea tridentata*), may need to grow for one to two years before planting to acquire the necessary root mass to survive without watering. Other critical elements in successful restoration projects which use container stock include 1) spring planting, 2) proper conditioning at the nursery, 3) anti-herbivory cages

around each plant, and 3) maintenance of the restoration project (Bauder and Larigauderie 1991). The National Park Service at Joshua Tree National Park, Viceroy Gold Mine, and Organ Pipe National Monument has established very successful nurseries for desert plants.

Seeds from native plants can be collected nearby and broadcast over or placed in imprinted depressions in the newly prepared soil. Although irrigating may be possible in some small locations, the success of most seedings is dependent on unpredictable rainfall. Broadcast seeding is relatively inexpensive, and, if rainfall is fortuitous, plants may become established at a relatively high density and in a random pattern. Although the methods for seeding are varied, they may not accomplish the desired restoration. However, seeding techniques are less time consuming and much less expensive than planting seedlings and may, in some cases, be as effective. The success of seeding projects is increased if seeding occurs immediately before the rainy season, seeds are covered, a mulch is used, and seeds are collected near the restoration site (Bauder and Larigauderie 1991).