

(approximately 14,164 ha [35,000 ac]) Open Areas.

The California State Department of Parks and Recreation (CSDPR 2002) has reported an increasing popularity of OHV activity in California, with a 30 percent increase in dirt bike registrations, a 96 percent increase in the number of All-Terrain Vehicle registrations, and a 96 percent increase in Dune Buggy and Sand Rail registrations from 1983 to 2000. The number of 4 wheel-drive vehicles registered in the state increased 74 percent from 1994 to 2001. The visitation rate to State Vehicular Recreation Areas in California increased 52 percent from 1985 to 2000. The Ocotillo Wells SVRA contains the majority of the greater than 36,423 ha (90,000 ac) in California's six SVRAs. These upward trends in OHV use in California can be expected to continue as the U.S. Census Bureau estimates California's population to increase by 39 percent, from 32 million to 45 million people by the year 2020.

OHV activity can result in direct mortality of flat-tailed horned lizards and other sand dwelling lizards (Luckenbach 1975; Luckenbach and Bury 1983; Muth and Fisher 1992). Road mortality has also been documented to occur (Turner and Medica 1982, Muth and Fisher 1992, ICC 1999b, Young and Young 2000). Flat-tailed horned lizards may be more prone to road and OHV caused mortality than other lizards due their tendency to remain motionless when approached. OHV activity can also crush burrows used by flat-tailed horned lizards and modify habitat because of impacts to vegetation (Luckenbach 1975, Vollmer *et al.* 1976, Bury *et al.* 1977, Luckenbach and Bury 1983, Wilshire 1983), soil disturbance (Luckenbach 1975, Bury *et al.* 1977, Webb 1983, Strittholt *et al.* 2000); and introduction of non-native plants.

Past studies of OHV impacts on lizards (Busack and Bury 1974, Bury *et al.* 1977, Luckenbach and Bury 1983, Klinger *et al.* 1990, Beauchamp *et al.* 1998, Setser and Young 2000, Setser 2001, Gardner 2002, Grant and Wright 2002, Knauf 2002) have been largely inconclusive or cannot be readily applied across the species' range (*i.e.*, have limited inference space; Ratti and Garton 1994). Luckenbach and Bury (1983) reported that a pronounced reduction in flat-tailed horned lizard abundance around the Algodones Dunes had been anecdotally noted by scientists. Marked declines in herbaceous and perennial plants, arthropods, lizards and mammals in OHV-used areas compared with nearby control areas were also reported by

Luckenbach and Bury (1983). The declines, however, were for the Colorado Desert fringe-toed lizard (*Uma notata*) and beetles, and did not include flat-tailed horned lizards or ants. Similarly, the BLM (Knauf 2002) found that preliminary results from a comparative study on fringe-toed lizard abundance in OHV open and closed areas showed that abundance of fringe-toed lizards in the OHV-used areas of the Algodones Dunes was significantly lower than in areas closed to OHVs.

Research was conducted in creosote-dominated habitats in the Mojave Desert. Researchers compared reptile metrics (measures) between sites used differentially by OHVs and control sites (Bury *et al.* 1977). Bury *et al.* (1977) found a significant decrease in numbers of reptiles on ORV-used areas compared with numbers on control sites in the Mojave Desert. However, the highest number of desert horned lizards (*Phrynosoma platyrhinos*) on any one plot occurred on a moderately used OHV site. In research conducted by both Busack and Bury (1974) and Bury *et al.* (1977), there appeared to be an inverse relationship between increased use of OHVs and the abundance of lizards. Grant and Wright (2002) reported that OHV use was negatively correlated with flat-tailed horned lizard abundance on 12 plots on the Yuha Basin MA; however, the correlation was not statistically significant.

Research in the Ocotillo Wells SVRA found flat-tailed horned lizards at higher densities in non-sandy habitats than sandy habitats within the SVRA, which differed from most other research findings (Beauchamp *et al.* (1998). It was unclear, however, if flat-tailed horned lizards were found in these atypical habitat types because they are more plastic in habitat use than previously thought, these habitat types are more available in the Ocotillo Wells SVRA than other areas in which flat-tailed horned lizards have been studied, or as a response to OHV activity (Beauchamp *et al.* 1998). Beauchamp *et al.* (1998) stated that most of the sandy areas were heavily affected by OHV activity compared to the habitat types where flat-tailed horned lizards were more dense.

Setser and Young (2000) and Setser (2001) found flat-tailed horned lizards avoided OHV disturbed areas. However, there was no difference in flat-tailed horned lizard habitat use between areas within 10 m (33 ft) of OHV trails and sites further away from OHV trails (Setser and Young 2000, Setser 2001). Setser and Young (2000) and Setser (2001) concluded that (1) OHV use might render sites less suitable to flat-

tailed horned lizard use, because of the impacts of OHV activity on vegetation and soil characteristics; or (2) OHV trails occur on sites not preferred by flat-tailed horned lizards (*e.g.*, barren ground with no plants or rocks). However, Gardner (2002) suggested that OHV activity did not have an effect on flat-tailed horned lizards at two different areas in the Ocotillo Wells SVRA, on the basis of observations. Similarly, Grant and Wright (2002) found that abundance of flat-tailed horned lizards was more correlated with percentage of sand cover than level of OHV disturbance.

In conclusion, while there has been some research on the adverse effects of OHV activity on vegetation, soils, and flat-tailed horned lizards, its applicability to flat-tailed horned lizard populations is limited and unreliable, because of the lack of scientific rigor associated with the research designs. Additionally, the effects of OHV activity on flat-tailed horned lizard populations were not the primary research questions. Nevertheless, these studies have utility in generating hypotheses concerning variation in degree of OHV use and flat-tailed horned lizard abundance. At this time, we feel that the available studies do not collectively show that OHV activity causes declines in flat-tailed horned lizard populations in the four different geographic areas in the United States, or that adverse OHV impacts pose a significant threat to these populations. Management activities, including efforts to reduce conflicts with actions that impact flat-tailed horned lizard habitats, would be enhanced by focused research. Impacts of OHV activity on flat-tailed horned lizard populations should be studied using rigorous research designs to yield conclusions with high degrees of certainty (Ratti and Garton 1994) regarding the effects of OHV activity on flat-tailed horned lizard populations across the geographic areas previously mentioned.

The Management Strategy includes specific planning actions to "Maintain information exchange and coordination of monitoring, management activities, and research" and "Encourage and support research that will promote the conservation of [flat-tailed horned lizards] or desert ecosystems." Research priorities include techniques for assessing abundance, life history, demographics, and effects of activities (including OHV use and associated activities). The research is conducted by the appropriate land management agency. We expect that future studies on these research priorities will provide the Service with the information necessary