

The relationship between scat counts and lizard abundance is unclear, or weak at best (Wright 2002). Wright (2002) states that while differences in scat abundance could indicate differences in lizard abundance, the observed decline in the rate at which scat is found could also be a result of an increase in Off-Highway Vehicle (OHV) activity resulting in crushed or buried scat, lower deposition rates, greater wind eradication, different observers, or additional factors. Furthermore, the use of scat counts does not account for variations in lizard activity, misidentification of scat from other species, scat production due to fluctuating food resources, weather conditions that affect scat production or longevity in the field, observer differences, and small sample sizes (Muth and Fisher 1992, Rorabaugh 1994). Consequently, scat abundance may not be positively correlated with lizard abundance under varying conditions (Rorabaugh 1994, Beauchamp *et al.* 1998). In addition, the use of a relative index, such as scat counts, to indicate population trends is not reliable due to uncorrected bias that exists (discussed further below). Relative index techniques assume that any changes or differences in survey results are proportional to true changes or differences in the populations of interest (Thompson *et al.* 1998). Thus, due to the significant limitations of scat count data, we consider the use of scat count information useful primarily in determining the distribution and presence of flat-tailed horned lizards.

Two measures of abundance trends (*i.e.*, lizards detected per 10 hours, and lizards per transect) used between 1979 and 2001 for the East Mesa, West Mesa, and Yuha Basin, did not include scat data (Wright 2002). No statistically significant trends were found in the rate at which lizards were detected or the number of lizards per transect on any of the areas from 1979 to 2001 (Wright 2002). The measure of lizards per transect has inherent error due to differences in transect lengths surveyed among years. More importantly, the methodologies used between 1979 and 2001 have varied and the data have not incorporated detection probabilities (see Thompson *et al.* 1998). Because flat-tailed horned lizards are very difficult to find in the field due to their cryptic coloration and behavioral characteristics, incorporating the probability of detecting them into survey results is very important.

Detectability is a common source of bias that is ignored for relative index techniques, such as the techniques used to collect the data between 1979 and

2001. Numerous factors may affect the detectability of animals within selected sampling plots. These include physical structure and cover, weather, individual behavior, and survey methodology. However, it is possible that differences in relative abundance found using uncorrected data may result from only a difference in detectability of animals between areas or within the same area across time (Thompson *et al.* 1998). Uncorrected bias could seriously affect the validity and usefulness of data in indicating abundance trends (Thompson *et al.* 1998).

The BLM recently estimated the population size on the Yuha Basin Management Area (MA) (one of five management areas identified in a management strategy for the species) by using capture-mark-recapture (CMR) techniques incorporating detection probabilities (see Thompson *et al.* 1998, Williams *et al.* 2002). In the summer (June to August) of 2002, the population of flat-tailed horned lizards for the Yuha Basin MA (24,122 ha [59,605 ac]) was estimated at 18,494 adults (95 percent CI = 14,596 to 22,391) (Grant and Wright 2002) and 8,685 juveniles (95 percent CI = 6,860 to 10,510) (derived from Grant and Wright 2002). "Adults" included all lizards greater than 60 millimeters (mm) (Young and Young 2000), while "juveniles" included all lizards 60 mm or less in snout-to-vent length. Population estimates for the other four MAs using a CMR methodology will be conducted soon, for the first time (Gavin Wright, BLM biologist, pers. comm. 2002).

Greater than 95 percent of the diet of flat-tailed horned lizards consists of ants of the genera *Messor*, *Pogonomyrmex*, *Conomyrma*, and *Myrmecocystus* (Turner and Medica 1982, Pianka and Parker 1975). Flat-tailed horned lizards are oviparous (egg-laying), early maturing, and may produce multiple clutches within a breeding season (Howard 1974). Flat-tailed horned lizards produce relatively small egg clutches ($N = 31$; mean clutch size = 4.7; range = 3 to 7; Howard 1974), compared to most other horned lizards (Pianka and Parker 1975). The first cohort hatches in July to August (Muth and Fisher 1992; Young and Young 2000), and in some years a second cohort may be produced (Howard 1974, Young and Young 2000). Hatchlings from the first cohort may reach sexual maturity after their first winter season, whereas hatchlings born later may require an additional growing season to mature (Howard 1974, Young and Young 2000). Flat-tailed horned lizards can live up to at least 6 years in the wild (FTHL-ICC

2002), and up to 9 years in captivity (Baur 1986).

Flat-tailed horned lizards can have relatively large home ranges (Foreman 1997). Muth and Fisher (1992) found the mean home range for lizards ($N = 22$) was 2.7 ha (6.7 ac) from a minimum of 19 locations in West Mesa. In the Yuma Desert of Arizona, Young and Young (2000) found mean home ranges for males differed between drought and wet years, while those of females did not. The mean home range for males was 2.5 ha (6.2 ac) during a dry year versus 10.3 ha (25.5 ac) during a wet year. Female mean home ranges were smaller at 1.3 ha (3.2 ac) and 1.9 ha (4.7 ac) in dry and wet years, respectively (Young and Young 2000). Young and Young (2000) noted a wide variation in movement patterns, with a few home ranges estimated at greater than 34.4 ha (85 ac).

Flat-tailed horned lizards generally lie close to the ground and remain motionless when approached (Wone 1995); however, but on occasion they may bury themselves in loose sand if it is available (Norris 1949). More rarely they may flee. Their propensity to remain motionless and bury themselves in the sand, along with their cryptic coloration and flattened body, make them very difficult to find in the field (Foreman 1997). During the summer, a flat-tailed horned lizard may escape extreme surface temperatures either by burying the main part of its body below the surface layer (Norris 1949) or by retreating to a burrow (Rorabaugh 1994, Young and Young 2000).

Adult flat-tailed horned lizards are reported to be obligatory hibernators (Mayhew 1965), although individuals have been noted on the surface during January and February (Eric Hollenbeck, Ocotillo Wells SVRA biologist, pers. comm. 2002). Hibernation may begin as early as October and end as late as March (Muth and Fisher 1992). Hibernation burrows appear to be self-constructed (constructed by the lizards themselves versus using burrows constructed by other animals) and are within 10 cm (3.9 in) of the surface (Muth and Fisher 1992). Mayhew (1965) found that the majority of lizards hibernated within 5 cm (2.0 in) of the surface. The greatest depth recorded was 20 cm (7.9 in) below the surface. While most adults apparently hibernate during winter months, some juveniles may remain active (Muth and Fisher 1992).

In June of 1997, seven Federal and State agencies signed a Flat-Tailed Horned Lizard Conservation Agreement (CA) to implement a Flat-tailed Horned Lizard Rangewide Management Strategy (Management Strategy). The purpose of