04-03

Ecology of Round-tailed Ground Squirrels at Casa Grande Ruins National Monument: Final Report

Our National Parks and Monuments serve as valuable sanctuaries for the conservation of biodiversity within a region (Halvorson and Davis 1996) and a place for scientists, naturalists and the general public to view and learn about the biota of an area. Often the species most sought after are large-bodied but secretive mammals that are charismatic; however, great scientific, aesthetic, and educational value can be ascribed to species that are highly visible and can be indicative of a region's biota. One such species is the round-tailed ground squirrel (*Spermophilus tereticaudus*) a common resident of natural areas in the Sonoran Desert of Arizona and Sonora, Mexico (Hall 1981). This small-bodied ground squirrel lives in matriarchical colonies of at least several adult animals (Dunford 1977) and is diurnal during the active season that ranges from late winter until late summer (Ernest and Mares 1987). Because of these habits, round-tailed ground squirrels are conspicuous members of the mammalian fauna throughout much of the Sonoran desert that includes several National Parks and Monuments (Hoffmeister 1986, Olin 1982) in the southwestern US.

Despite their conspicuous nature, round-tailed ground squirrels are among the least studied species of mammal in the Sonoran Desert and many of the details of the most basic aspects of their biology are poorly understood (Hoffmeister 1986). Ecological and behavioral studies are essential to provide critical baseline data for assessment by wildlife managers and conservation biologists. Population structure, social structure, and activity patterns of a species are important data for conservation biologists to predict a population's response to habitat disturbance or fragmentation and wildlife managers to recommend solutions for management.

Round-tailed ground squirrels show great promise as a focal species for interpretive efforts in educating park visitors because they are common, highly visible, and are well adapted to desert life. At the Casa Grande National Ruins Monument (CAGR) round-tailed ground squirrels are highly conspicuous particularly in the picnic area and on the grounds surrounding CAGR's main attraction, the Casa Grande.

However, this also creates concerns for park management with human-wildlife interactions that include not only ground squirrels but rattlesnake predators.

Round-tailed ground squirrels present additional management issues at the Casa Grande National Ruins Monument. Burrows in and around potentially important archeological sites create compromises in structures and potentially mix soil layers that would complicate future archeological analyses. Thus, management issues in mitigation of damage to important prospective archeological sites are of utmost importance. Without basic ecological data on round-tailed ground squirrels these management issues are difficult to address.

Objectives

The specific objectives of this research were to:

1.) To determine the movement patterns of round-tailed ground squirrels at Casa Grande Ruins National Monument

2.) To assess the distribution of amicable and agonistic interactions within a population of round-tailed ground squirrels and define the social system of round-tailed ground squirrels

3.) To delineate periods of aboveground activity of various age and sex classes of round-tailed ground squirrels

4.) To collaborate with the staff of Casa Grande Ruins National Monument to develop interpretive materials that highlight the ecology of round-tailed ground squirrels

Methods

Study Area. Round-tailed ground squirrels are found throughout the open Sonoran Desert vegetation within the Casa Grande Ruins National Monument, Coolidge, Arizona. All animals within two-50 m x 50 m study plots were marked with a combination of freeze-marking and hair dye to allow identification of individuals.

Live Trapping, Marking, and Observations. Round-tailed ground squirrels were studied with standard methods of capture, handling, marking and observation approved by the American Society of Mammalogists and the Animal Behavior Society. Squirrels are live trapped in shade covered, Sherman box traps baited with sunflower seeds and

peanut butter and checked hourly during early morning and evening hours dependent on temperature conditions. Captured individuals are transferred to a cloth-handling cone with velcro portals permitting the handler access to animals (Koprowski 2002). Each round-tailed ground squirrel is also provided a unique pattern of black hair dye and freeze-mark (Rood and Nellis 1980, Koprowski 1996) enabling identification of individuals at a distance during behavioral observations. Animals are weighed ($\pm$ 5 g) and the age class (Adult, Subadult, Juvenile), sex class, reproductive condition (Males: Scrotal, Abdominal; Females: Nulliparous, Past Lactation, Pregnant, Lactating, Pubic Symphysis Open or Closed), hind foot length, shin length, and parasite load determined. All individuals are released at the point of capture. Individuals will be observed during periods of aboveground activity using scan sampling at 20-min intervals; the location, behavior, and distance to nearest neighbor of all animals will be recorded. Home ranges will be approximates. These data will permit determination of patterns of association within the population of round-tailed ground squirrels and enable the influence of habitat features and kinship on space use to be examined. Dispersal patterns of marked juveniles will also be assessed through standardized surveys of the surrounding areas for evidence of juveniles marked on the study site.

These methods were modified from the initial proposal due to study modifications after initial assessments were made and complications after a decision by CAGR to implement some experimental pest management techniques which included shooting and poisoning focal animals and areas adjacent to study plots in the late summer of 2005.

Results

A total of 323 unique squirrels have be captured, marked, a DNA sample taken and released. In 2004 an attempt to mark the entire population was abandoned. In 2005 two, $50m^2$ plots were created to follow individual squirrels behavior and female reproductive characteristics. In 2005 there were 16 female resident ground squirrels on the two plots. In 2006, there were 8 female residents on the 2 plots.

Objective 1) *To determine the movement patterns of round-tailed ground squirrels at Casa Grande Ruins National Monument.*

Home ranges were larger than the 50 m^2 plots that we used for our study as focal animals were commonly found > 50 meters from their burrows. Females can predictably be found at a single burrow within their home range. New unmarked males were regularly trapped in the plots throughout the season whereas non-resident females were rarely trapped. Males are capable of moving more than 800 meters, straight line distance, in a day (2004) as indicated by live captures. Almost all juveniles dispersed from the natal area. Only 3 of the 16 resident females in 2005 were still residents in the plots in 2006. Systematic searching of the area found one female had shifted her burrow approximately 300m away from the plot and into the picnic area. This high turnover rate is most likely due to the combination of the average annual turnover rate and the elimination of squirrels by the USDA hired by CAGR that took place during the late summer of 2005.

Objective 2) *To assess the distribution of amicable and agonistic interactions within a population of round-tailed ground squirrels and define the social system of round-tailed ground squirrels.*

Time budgets were compiled for both males and females separately. No differences were found between adult males and females in their time budget (Figure 1.) Most time was spent foraging and feeding (56%) or basking (15%). Few agonistic interactions occurred between adult squirrels. Less than 1% of their daily time budget could be attributed to agonistic interactions. Approximately, 1% of time was spent in amicable interactions. Amicable interactions do not include vocalizations which were 2% of time spent. Males were amicable even when in reproductive condition with fully descended testes. Two males in reproductive condition were observed to share a burrow well into the mating season (last observation: February 26th, 2006.)

Objective 3) *To delineate periods of aboveground activity of various age and sex classes of round-tailed ground squirrels.*

Males emerge from burrows at least 1-3 days prior to females in late January early February as reflected in trapping observations where males were caught on average 2.3 days before females. Similar patterns of above ground activity were seen in 2004 and

2005. Females entered breeding condition between 22 February and 28 February. By early April most adult males had become inactive and gone into estivation except for a few daily emergences. Young first emerged from burrows between 21 April and 30 April and were dispersed and entering estivation by 1 July. However, in 2006 females did not become reproductive active until 13 March; young first emerged from their burrow on 26 May and squirrels did not enter estivation until 1 August.

Objective 4) *To collaborate with the staff of Casa Grande Ruins National Monument to develop interpretive materials that highlight the ecology of round-tailed ground squirrel.*

This objective has been highly successful in educating staff, volunteers and the public. A pamphlet has been created and is distributed to the public when more information about round-tailed ground squirrels is requested. Several posters have been created for use in the visitor center. K. Munroe has given 4 invited public lectures and 2 lectures for the National Park Service including a regional conference on Vanishing Treasures and Integrated Pest Management issues. K. Munroe has also answered over 50 emails from the CAGR's web page link concerning questions about round-tailed ground squirrels and their ecology.

Discussion

Home ranges are larger than 0.25ha. Females appear to take up residency and remain loyal to a site whereas males tend to range further and not be as tightly associated with a particular burrow. It has been observed that males can range great distances over 11 home range sizes. There was no sex bias in dispersal noted and less that 20% of resident females where present in the following year. This would suggest that either matriarchical colonies (Dunford 1977) are not likely formed in this area or were greatly influenced by the shooting or poisoning that took place in the late summer of 2005. Genetic analysis would be able to confirm this lack of matriacrchical society and any dispersal of animals in or out of CAGR.

Even though squirrels living in close proximity do not appear to be highly related to one another low levels of agonistic interactions occur. Most time is allotted to foraging and eating (Figure 1.) This is most likely due to the low quality of food

available within the habitat. In 2004 and 2005 similar patterns of above ground activity for adult and juvenile squirrels were seen however, 2006 shows a delayed breeding season, young emergence and estivation. This may be attributed to the lack of precipitation seen during the winter of 2005-2006; almost 5 months (October 13, 2005-March 11, 2006) passed between precipitation events. This greatly impacted amount of available vegetation for forage and in turn the body mass and condition of the ground squirrels (Figure 2.)

Round-tailed ground squirrels spend most of their time foraging and feeding. It appears that the amount of forage has a direct impact on the litter size of the squirrels. For future management decisions a reduction in available food would serve to effectively mitigate high densities of squirrels. In addition, round-tailed ground squirrels spend very little time digging particularly new burrows. The majority of time spent digging in existing burrows. Therefore, the damage of the squirrels and their burrows to potential archeological sites is not great.

Much of this information has been disseminated to the CAGR staff, volunteers, and visitors. There appears to be a greater understanding of the ecology and the important role that these squirrels play in the ecosystem. This study has also helped shape management decisions within the Casa Grande National Ruins Monument and other National Parks in the desert southwest. Future studies will only further elicudate round-tailed ground squirrel's role in the ecosystem.

Literature Cited

Dunford, CC. 1977. Social system of round-tailed ground squirrels. Animal Behavior 25: 885-906.

Ernest, K. A., and M. A. Mares. 1987. *Spermophilus tereticaudus*. Mammalian Species 274:1-9.

Hall, ER. 1981. Mammals of North America. Wiley, New York.

Halvorson, WH and GE Davis. 1996. Science and ecosystem management in the national parks. University of Arizona Press, Tucson.

Hoffmeister, DF. 1986. Mammals of Arizona. University of Arizona Press, Tucson.

Koprowski, JL. 2002. Handling tree squirrels with a safe and efficient restraint. Wildlife Society Bulletin 30:101-103.

Olin, G. 1982. Mammals of the Southwest Deserts. Southwest Parks and Monuments Association, Tucson.