Spring 2004

The Effects of off-road vehicle use in Desert Tortoise (Gopherus agassizii) habitats

Brent D. Clark
University of Nevada Las Vegas

The Effects of Off-Road Vehicle use in Desert Tortoise (*Gopherus agassizii*) Habitats

A thesis submitted in partial satisfaction of the requirement for the degree of Bachelor of Arts

In

Environmental Studies

UNIVERSITY OF NEVADA Las Vegas

By

Brent D. Clark

Spring 2004

Thesis Advisor: Dr. Patrick Drohan

Abstract

The desert tortoise (*Gopherus agassizii*) populations have been in decline and have been placed on the endangered species list. No single factor is ultimately responsible for the tortoise decline. It is a combination of events that collectively have a negative impact. I chose to focus my study on only one factor, off-road vehicles. By evaluating the damage done to the terrain by off-road vehicles, a better understanding of their impact on the tortoise populations can be assessed and protective measures taken.

The amount of available vegetation does not seem to play a role in their decisions of which plants to eat. If vehicles are destroying the native plants required by the tortoise, then a decline in population could happen. Tortoises also make a majority of their burrows next to plants to have more shade and result in being less visible. This leads to the unintentional crushing of the tortoise burrow.

Not only do these vehicles destroy burrows and vegetation they also compact the soil making plant growth more difficult while decreasing the amount of available vegetation. The amount of soil compaction will be measured by means of a bulk density analysis.

There will be one test site and one control site. Each site will be 0.6 square miles in size and the test site will have an off-road track running through the middle of it. Transects will be ran in order to record burrow locations.

Introduction/Background

The United States Fish and Wildlife Service have listed the desert tortoise (*Gopherus agassizii*) as a threatened species for over two decades. Aside from being on the brink of becoming an endangered species, they have also been placed on the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) list as well. CITES became active in 1975 and today protects more than 30,000 species of plants and animals from the billion dollar trade industry (Hutton, Dickson 2000).

The desert tortoise habitat range encompasses southern Nevada, extreme southwest Utah, southern California, southwest Arizona, and into Mexico. They reside in altitudes between 700 meters and 1,070 meters (Ernst, Barbour 1989; Ernst, Barbour, Lovich 1994). Over the course of hundreds of years, the tortoises have adapted to survive the harsh conditions found in the desert and are an indicator species for the condition of the desert ecosystem (Wilkenson 1996).

During summer months the daily temperature can be upwards of 110 degrees Fahrenheit and the ground temperature can reach over 140 degrees Fahrenheit (Desert USA 2004). To avoid these extreme temperatures that occur in the desert, the tortoises excavate areas near washes and make use of their forelimbs to shovel soil away and push it out to create a comfortable burrow. The burrows provide a more humid and cooler microclimate for the tortoise and serves as a great refuge for hatchlings.

The three main types of cover are as follows: non-burrow sites; burrows; and karastic cavities (Burge 1977). A non-burrow site is a broad term for almost anything producing ample shade whether it is a yucca or a large boulder. A burrow is dug by the tortoise or modified from a preexisting hole and is usually 2.4 to 4.6 meters in length (Ferri 1999). During the hotter months a tortoise will retreat to a summer hole that will go down three to four feet at a fairly sharp angle (Woodbury, Hardy 1940). A karastic cavity (den) is wider than a tortoise and can contain multiple chambers. It is primarily used between November and March when the tortoise hibernates (Burge 1977).

During a five-month study conducted by Bulova (1994) observed that a single tortoise would take refuge in nine different burrows with an average distance of 148.9 meters between them (Bulova 1994). Burge (1977) noted that over a course of one year a tortoise took advantage of 12-25 different cover sites (Burge 1977). The desert tortoise will usually be found alone with the exception of mating couples. The preferred locations for burrows are desert alluvial fans, washes, canyon bottoms, and rocky hillsides composed of more sandy or gravelly soil (Ernst et al. 1994). Unfortunately, desert washes are also the location of off-road vehicle (ORV) tracks. During Burge’s (1977) study observed that 67% of the excavated cover sites were located under shrubs. The dominate shrubs were larea, yucca, and acacia due to the amount of shade they are able to produce (Burge 1977).

Making burrows behind vegetation makes them less visible and more likely to be unintentionally crushed by a vehicle.

It was thought that since the rain would wash away the tracks no harm would be done to the environment. During a personal communication Dr. Burge stated that the desert tortoise would not relocate their burrows even if that location becomes an ORV track. This is due to the familiarity to the burrow's location. If a tortoise travels to one of its various burrows and discovers it crushed, it has two options. The first is to dig the burrow out and make it habitable again or just use the burrow in its current state. Digging a burrow takes 30 to 45 minutes to do completely and in over 100 degree temperatures that amount of time can kill la tortoise. The second option is to travel to the next burrow, which also takes considerable time resulting in prolonged exposure to the sun. It is very important that the tortoise does not lose too much water via evaporation so shade becomes a necessity (Burge 2004).

Burge (1977) found that out of 21 collapsed burrows, 15 of them were either reopened, used, or dug new ones at the same site, seven of these burrows were lost to ORV damage Burge (1977).

The desert tortoise has been well documented as being a finicky eater (Jenning 1993). This is problematic since the desert lacks dense vegetation. Succulent native annuals are the preferred diet and the growing seasons of these govern the movements of the tortoise (Jenning 1993). A majority of the water tortoises will intake will be from the succulent plants they consume usually eating the leaves and flower buds (Burge 1977). Some of these annuals are only available from April to June and only if the tortoise is able to find them (Ernst et al.).

Off-road vehicles directly increase soil compaction and hinder the growth of vegetation. ORV's may destroy the plants and also destroy the biological soil. There are many facets of plant growth aided by these crusts. The biological crust makes the soil resistant to wind and water erosion, increase water infiltration and also increases the amount of nutrients available to the plants due to the nitrogen fixation carried out by the cyanobacteria (National Park Service 2003). “Compacted soil can be a physical barrier to root growth, thus preventing plants from reaching necessary water and nutrients” (Warren 1996). Luckenbach and Bury (1983) noticed this to be true in their study in the California desert. This led them to conclude that “even minor levels of ORV use can cause a reduction in the biota of dunes ecosystems” (Luckenbach, Bury 1983

The fish and wildlife service responded to a comment stating that off-road vehicles do not cause a decline in tortoise population. Their response was as follows “Impacts include loss of vegetation required by tortoises for forage and cover, collapse of tortoise burrows, soil compaction which reduces surface water penetration and seed germination, and crushing tortoises” (Federal Register 1990).

Hypotheses

- Null hypothesis: Off-road vehicles do not have an effect on the desert tortoise habitat.
- Alternative hypothesis: Soils compaction will be high enough to prevent burrowing.

Methods

Study Area

The chosen test area is located in Jean, Nevada (latitude: N 35˚ 43.749’ longitude: W 115˚ 20.174’) southwest of Las Vegas. The area houses several off-road tracks and has been used for decades. Jean was also the location of a tortoise release site. My study site is located across the I-15 from the control site so, other than the landscape modifications produced by ORV's, each area should have equal potentials for suitability with regards to desert tortoise habitat. The elevation of Jean ranges between 900 meters and 1051 meters, most of which should be with in the suspected range of 700m-1070m.

Burrows

My plan is to use one control area and one test area each spanning 0.6 square miles in size. Tortoise burrow locations will be recorded by using a GPS unit. The GPS unit will record the coordinates of the burrow and I will record the following observations. Fresh scat and tortoise tracts will be used to determine the status of the burrow (active/inactive) and will be recorded as well as the damages (none, mild, moderate, high/destroyed) and the total number of burrows per site will also be recorded.

The total number of burrows will be compared between test sites and control sites as well as each of the damage categories.

Soil Compaction

Areas of high soil compaction will also be recorded. Soil bulk density is the ratio of the mass of dry soil to its volume which can be calculated in the field by "driving an open ended cylinder into the soil, smoothing the ends and then finding the dry mass of the enclosed soil" (Wild 1993). I predict that soils in the test areas will be more compacted than those in the control areas. I will follow the guidelines provided by the Global Learning and Observations to Benefit the Environment (GLOBE) to conduct this analysis.

The off-road track will be used in the test site for the bulk density measurements. The track should be more compacted than the soil at the control site. No areas in the control site are speculated to be more compacted than others. Random points will be used in measuring bulk density in the control site and their location will be recorded as well.

A Mann-Whitney U test will be employed to compare the compaction of the control site with that of the test site. The mean compaction for the test and control site will be calculated in addition to comparisons between the areas of track measured for compaction (low, high). Half of the test points lie in the dips of the track while the other half were taken at the high point of the track.

Results

The control site yielded a total of ten burrows that were all intact. They were spread throughout the landscape and their location and status may be found in table 1. There were only two burrows that were suspected of being unoccupied since there were spider webs covering the entrance of the burrows. No damages were done to any of the burrows and signs of occupation such as tracks or scat were not present. The burrow varied in size but these measurements were not recorded.

Table 1 burrow location

Burrow Locations (control site)

Burrow #	Latitude	Longitude	Description
1	N 35˚ 46.709'	W 115˚ 20.284'	Intact
2	N 35˚ 46.566'	W 115˚ 20.504'	Intact
3	N 35˚ 46.624'	W 115˚ 20.414'	Intact
4	N 35˚ 46.689'	W 115˚ 20.519'	not used (spider webs)
5	N 35˚ 46.286'	W 115˚ 21.172'	not used (spider webs)
6	N 35˚ 46.799'	W 115˚ 20.651'	Intact
7	N 35˚ 46.998'	W 115˚ 20.272'	Intact
8	N 35˚ 46.971'	W 115˚ 20.615'	Intact
9	N 35˚ 46.749'	W 115˚ 20.884'	Intact
10	N 35˚ 46.971'	W115˚ 20.676'	Intact

No tortoise burrows were found within the transects of the test site. There was however quite a few kit fox burrows throughout the test sight. There were some collapsed burrows that may have been those of tortoises, but with the amount of kit fox burrows in the surrounding area I was unable to determine with certainty whether or not it was a tortoise burrow.

There were 5 different soil sample clusters consisting of three samples each at the control site. Although very difficult, a can was employed to maintain a known volume of soil throughout the collection of soil. A center point was chosen and then samples were taken ten feet away from this point in the form of a “Y”. These 15 samples were then taken back to a lab to dry for a few days and were later weighed.

A different method was used when collecting the soil compaction data at the test site. Since using a can proved to be difficult in the control sight it would probably be too difficult to do on the track. Instead a small hole was dug with the soil being placed in a bag. Jugs of water had a marked starting point at the top of the water. The hole was then lined with plastic wrap and fill with water. The new water level was marked and the area between these two lines was identified by cluster and bag number. This was repeated for each of the holes with four different jugs being used. Back at the lab the empty jugs were filled up to the point where one hole stopped and the other one began, this amount was recorded and was the volume of the hole. This procedure was repeated for each of the samples

At the test site 10 soil sample clusters containing three samples each were collected. All of them were collected on the track and were all spaced over a distance of 222 feet. The holes were dug in a horizontal line evenly spaced across the track. Half of the samples were collected at the high points of the track while the remaining half was collected at the low points. A Mann-Whitney U test was employed to compare the compaction at the control site versus that at the study site. Table 2 shows the results of this analysis.

Table 2 Mann-Whitney u test of test and control sites

Test Statistics[a]

	Compaction
Mann-Whitney U	58.500
Wilcoxon W	178.500
Z	-4.010
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Site

Ranks

	Site	N	Mean Rank	Sum of Ranks
Compaction	control	15	11.90	178.50
	test	30	28.55	856.50
	Total	45		

There is a significant relationship between location on an ORV track or in open desert and the degree of compaction (U= 58.5 Sig. = 0.000).

Comparisons within the test site were made by comparing the bulk-density of the high points with the same variable in the low points of the track. This was done to see if one of these positions was more compacted than the other. The results are as follows in Table 3.

Table 3 comparing compaction in track high points with track low point.

	Compaction
Mann-Whitney U	108.500
Wilcoxon W	228.500
Z	-.166
Asymp. Sig. (2-tailed)	.868
Exact Sig. [2*(1-tailed Sig.)]	.870(a)

	POSITION	N	Mean Rank	Sum of Ranks
Compaction	low	15	15.77	236.50
	high	15	15.23	228.50
	Total	30		

With a P-value of 0.870 I conclude that there is no significant relationship between the position on the track and the amount of compaction. The mean compaction at the high points was 1.94 g/cm^3 while the mean at the low points was 1.98 g/cm^3.

Discussion

With the two sites I used for my study I conclude that ORV's do discourage the desert tortoise from establishing shelter in areas containing tracks by making the habitat inhospitable. The track was significantly more compacted than the control site was. Although areas off of the track were not measured for compaction, while walking transects I observed many tracks were found off of the course. The data does support the position that ORV's do compact the soil and that the compaction can become high enough to make the soil too dense to burrow into.

My hypothesis stating that the control site will contain more burrows than the study site was supported by the data collected. While ten burrows were found in the control site, no burrows were located within the test site. ORV's may be partially responsible for the lack of burrows but most likely are not solely responsible. The many kit foxes could be predators being avoided. There were also some issues with the location of the study site.

I tried to choose locations where the only difference would be the presence or absence of an off-road track. The two sites were separated by Interstate 15 South which made a real boundary. With the control site having desert tortoises previously released there it increased the chances of finding burrows while the test site did not have this benefit. I thought that if they were similar habitats and there were tortoises at the control site, then there might have already been an established tortoise population at the test site. There is also the possibility that the tortoises located themselves farther away from the track lying outside of my study site.

The time at which the study was conducted might have also been a variable that may influence the number of burrows. The data was collected during late March and early April and tortoise activity is low during this time. Tortoises hibernate during the winter so no new burrows will be made and fewer should appear active than in spring or summer. Winter may also be a time of less frequent off-road activities. In short, this study is not meant to predict general impacts on burrows and soil; it is for a specific season and only reflects winter. The methods of this study could be repeated in a different season and then compared to see seasonal trends over a year.

http://www.desertusa.com/june96/du_tort.html