Desert Tortoise Population Densities and Distribution, Piute Valley, Nevada

Randal W. Wilson and Robert D. Stager

A soils and vegetation survey was completed during April 1988 in Piute Valley, Clark County, Nev. The survey covered approximately 47,000 acres of Public Lands administered by the Bureau of Land Management located south of Searchlight, Nev., and 60 miles southeast of Las Vegas. Desert tortoise *(Gopherus agassizii)* have been studied in Piute Valley since 1979. The objectives of the survey were to compare soils and vegetative characteristics to tortoise density and distribution and attempt to identify soils characteristics that may be used to predict tortoise distribution and densities.

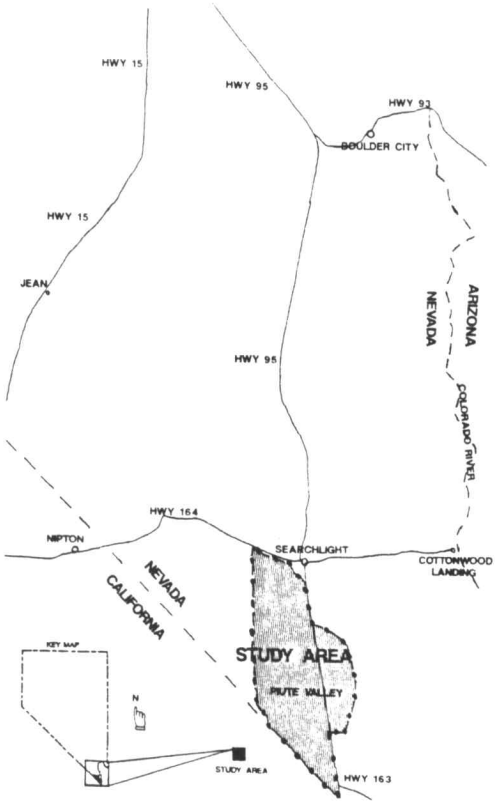


Fig. 1. *Location of the study area, Piute Valley, Nevada.*

The climate is typical Mojave Desert with cool winters and hot summers. The area receives 5 to 8 inches of precipitation annually from low intensity uniformly distributed winter storms and scattered, high intensity summer storms. The elevation varies from about 2,300 feet to 3,500 feet. The major physiographic parts of the valley are the Piedmont slopes and the basin floor. The three major landform types of the Piedmont slopes are erosional fan remnants, inset fans, and fan skirts. The vegetation community surveyed were creosote/white bursage with the herbaceous understory ranging from predominantly a mixture of introduced and native annual forbs and grasses in the southern portion of the area to perennial grasses with annuals in the north.

The soils and vegetation were classified and analyzed using standard USDA-SCS and USDI-BLM field methods. The vegetation was categorized to range site (ecological site). Soil properties examined included rock fragment content, texture, consistence, pH, color, effervescence, and electroconductivity. Vegetation data consisted of air dry production by plant species, determination of range condition (ecological status) and the correlation of range sites to soils.

The presence or absence of tortoise sign was documented during the soils and vegetation mapping to supplement existing tortoise data. Soil transects were carefully located to represent the dominant soil types, determine soil map unit percent composition and compare to the tortoise distribution and density data and field observations to determine if an association may exist.

Results

Eight soil map units were developed in the study area from the soil survey. Map units 1 through 7 will be discussed in this paper. The climatic conditions were ideal for studying spring vegetative growth responses on the different soils. The winter and spring storms were documented on site as gentle and uniform with a good 5 to 10 inches percolation into the soil profile throughout the survey area. Any vegetative differences are interpreted as being more a function of soil properties and characteristics than climate for this study.

The first area reviewed, soil map unit 1, is located along the old railroad grade southwest of Searchlight. The component landforms in this soil mapping unit are erosional fan remnants with an alternating pattern of inset fans. The dominant soil in this unit occurs on erosional fan remnants and is classified as a fine-loamy, mixed thermic Ustalfic Haplargids representing 60 percent of the unit. There is a limiting argillic horizon from 11 to 43 inches. Tortoise burrows were lacking in this soil though sign and tortoise activity were documented.

The second major soil in this unit is located in the inset fans, and is classified as a coarse-loamy, mixed, calcareous, thermic Ustic Torriorthents representing 35 percent of the unit. This profile lacks any restrictive soil feature

The authors are Soil Conservationist, U.S. Department of Agriculture, Soil Conservation Service, Las Vegas, Nev.; Range Conservationist, U.S. Department of Interior, Bureau of Land Management, Las Vegas, Nev., respectively.

and has stable structural strength throughout the profile.

This map unit has a low to medium density of desert tortoise with about 50 to 100 per square mile. Tortoise burrows occurred predominantly in the inset fans. Creosote bush, white bursage, and big galletta grass are the major perennial plant species present. Twelve native annuals and three introduced annuals were identified.

Soil map unit 2 is located approximately two miles southwest of the Searchlight landing strip. The component landforms in this unit are fan skirts with intermingled stream terraces. The dominant soil in this unit occurs on fan skirts, and is classifed as a coarse-loamy, mixed, thermic Typic Camborthids. It represents 50 percent of the map unit.

The second major component occurs on stream terraces and is classified as a coarse-loamy, mixed, thermic Typic Calciorthids representing 35 percent of the map unit.

This map unit has a low to medium density of desert tortoise with about 50 to 100 per square mile. Tortoise distribution appeared to be the same in both major soils. Creosote bush, white bursage, and big galletta grass are the major perennial plant species present. Ten native annuals and three introduced annuals were identified.

Map Unit 3 Showing greater vegetative production and canopy cover associated with a good Available Water Capacity.

Soil map unit 3 is located east of the town CalNevAri. This unit covers most of the valley bottom. The component landforms in this unit are fan skirts and stream terraces. The dominant soil in this unit occurs on fan skirts and is classified as a coarse-loamy, mixed, thermic Typic Camborthids representing 65 percent of the map unit.

The next major component in this unit occurs on stream terraces and is classified as a coarse-loamy, mixed, thermic Typic Camborthids representing 25 percent of the map unit.

This map unit has the highest density of desert tortoise with 150 or greater per square mile. Tortoise burrows appeared to be uniformly distributed on both soils. Creosote bush, and white bursage are the major perennial plant species present. Seven native annuals and two introduced annuals were identified.

Map unit 4 is located south of Ten Mile Well in the south central part of the survey area. This unit has three major components that occur in a complex association. They are fan skirts, fan remnants, and inset fans.

The dominant soil in this unit occurs on fan skirts and is classified as a coarse-loamy, mixed, thermic Typic Camborthids representing 55 percent of the unit.

The second component in this unit occurs on fan remnants and is classified as a loamy-skeletal, mixed, thermic Typic Calciorthids representing 20 percent of the map unit.

The third component occurs in inset fans and active channels and is classified as a sandy or sandy-skeletal, mixed, thermic Typic Torriorthents representing 16 percent of the map unit. This soil is occasionally flooded, with flooding generally occurring during prolonged high-intensity storms in the mid and late summer months.

This area has a medium to high density with 100 to 150 and 150 or greater animals per acre. Component 1 had most of the tortoise burrows. Fewer tortoise sign was noted in component 2 with very or extremely cobbly surfaces and in component 3. Creosote bush, and white bursage are the major perennial plant species present. Nine native annuals and two introduced annuals were identifed.

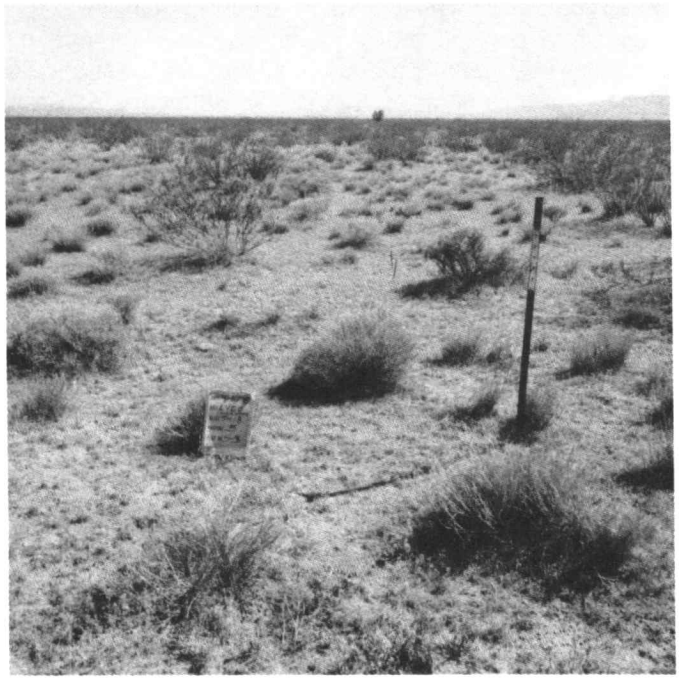
Map unit 5 is located in the southern portion of the survey area. The two major components are eolian sand sheets and inset fans occurring in an association.

The dominant soil occurs on the eolian sand sheets classified as a mixed, thermic, Typic Torripsamments representing 70 percent of the unit. This soil lacks any structural strength and has loose soil consistence throughout the profile.

The second major component occurs on fan skirts that are intermingled along the periphery of the unit and is classified as coarse-loamy, mixed, thermic Typic Camborthids.

No tortoise burrows were noted in the eolian sand sheet soil with most burrowing activity identified on the fan skirts. Tortoise density is low to medium with about 50 to 100 per square mile in this map unit. Creosote bush, and white bursage are the major perennial shrub species present with 3 to 40 percent, by weight, big galletta grass. Five native annuals and one introduced annual were identified.

Map unit 6 is divided by U.S. Highway 95 south of Searchlight, Nev. The component landforms in this unit are erosional fan remnants with alternating patterns of inset fans and active channels. The dominant soil in this unit occurs on fan remnants and is classified as a Fine-



Map Unit 2 Showing less vegetative production and canopy cover associated with a lower Available Water Capacity.

loamy, mixed, Thermic Typic Haplargids representing 50 percent of the map unit. Tortoise burrowing activity was not observed on this soil.

The next major component in this unit occurs on inset fans and is classified as a coarse-loamy, mixed, thermic Typic Camborthids representing 35 percent of the map unit. Tortoise burrowing activity was prevalent in this soil. Tortoise density is medium to high with about 100 to 150 per square mile.

Creosote bush, and white bursage are the major perennial plant species present. There were over seven native annuals and one introduced annual identified.

Map unit 7 is located due west of the power line corridor running in the middle of the survey area. The component landforms in the unit are deeply dissected erosional fan remnants with narrow alternating pattern of inset fans and active channels. The dominate soil in this unit occurs on summits of fan remnants and is classified as a fine, montmorrillonitic, thermic Petrocalicic Paleargids representing 55 percent of the unit.

No burrowing activity was noted on this soil and population studies show this area to be a lower density tortoise area. The inset fans and washes cutting through this soil often expose the indurated petrocalicic or "caliche" horizon where burrowing activity was noted underneath the layer.

The next major components in this unit occurs on side slopes of the fan remnants and is classified as a loamy, mixed, thermic shallow Typic Paleorthids representing 30 percent of the unit. Most of the tortoise burrows and activity noted were on this soil, and the insets and washes which comprise 15 percent as inclusions in the mapping unit. Tortoise density is low to medium with about 50 to 100 per square mile in this map unit.

Creosote bush, and white bursage are the major perennial plant species present with trace to 3 percent, by weight, big galleta. Spanish dagger is common on the fan remnants. There were over four native annuals identified and two introduced annuals.

Conclusions

The objective of the survey was to compare soils and vegetative habitat characteristics to tortoise density and distribution and identify possible soils and geomorphic relationships that may be associated and later used in the field to predict tortoise distribution and densities for similar soils.

Dr. Hardy, as quoted in E. Jaegers *Desert Wildlife* (1961) concluded that soils largely determine habitat and distribution of the desert tortoise. Hardy determined that the soil must be sufficiently free from rocks to permit digging and compact enough to maintain a strong archway over the burrow. Woodbury and Hardy (1948) and Miller and Stebbins (1964) found that tortoise habitat types are restricted to suitable soils for den construction. Luckenbach (1976) noted that preferred habitat types in the Providence Mountains region were areas with good denning potential having soil characteristics of sandy loam to light gravel clay.

The observations and data collected for this paper in Piute Valley corroborate earlier findings and go further to suggest an association between certain soil characteristics and geomorphic relationships and tortoise density and distribution.

The soil characteristics identified were available water capacity (AWC), soil consistence, depth to a limiting layer, rock fragment content, soil salinity, soil temperature, and frequency of flooding.

The greater AWC, the greater the vegetative productive capacity under the same climatic regime. In soils with similar denning characteristics, forage productivity may be more important for determining tortoise densities due to available forage and canopy cover as indicated in the photos for map units 2 and 3. Soil consistence considers the structural strength and limits to digging in a soil. Soils with good structural stability and little to no digging limitations as in map unit 3 appear to provide better tortoise burrow locations.

Depth from the surface to a limiting layer is defined as the depth to lithic or paralithic contact and/or to a hardpan. A limiting layer within 0 to 20 inches of the surface as occurs in the dominant soil in map unit 1 may restrict tortoise burrowing activity, affecting their distribution and population density. Tortoise burrows usually fall within 40 inches of the surface and are crucial to surviving the winter cold and summer heat.

Rock or coarse fragment content is determined on a percent by weight basis. Soils with very cobbley and extremely cobbley surface textures may limit tortoise mobility on the surface. The more gravel or rock fragments present in the profile, as in map unit 2, the lower the

Table 1. Soil properties that may be associated with desert tortoise distribution and density.

	Elements/Soil Property	Restrictive Feature
1.	Dry soil consistence at 0-40 inches	Structural strength, limited digging
2.	Available water capacity	Droughty
3.	Depth to limiting layer in inches	Depth to rock or cemented pan limiting depth of digging
4.	Coarse fragments (pct by wt > 3 inches size) on surface layer	Surface mobility may be limited
5.	Salinity (MMHOS/CM)[1]	Excess salts
6.	Soil temperature (at 20 in. in degrees F)	Temperature at burrows depth
7.	Flooding	Flooding
8.	Soil horizon properties (0 to 40 in.)	Limited digging

[1]The soils in Piute Valley had low salinity levels at < 2 MMHOS/CM with medium high tortoise densities. The Eldorado Valley located NW of Piute Valley has low tortoise densities and it's soils have salinity levels > 8 mmhos/cm.

structural stability of a burrow and the harder it is to dig. How soil salinity may affect tortoise distribution and density is not certain. There may be a relationship between the water balance of the tortoise and the saline content of the forage and the soil in the burrow itself.

Soil temperature is defined as the mean annual temperature at a depth of 20 inches. This soil property is divided into greater than 59 degrees Fahrenheit (F) and less than 59 degrees F. This temperature break coincides with the boundary between the Thermic (59 to 72 degrees F) and Mesic (47 to 59 degrees F) soil temperature regimes. It also coincides with the northernmost geographic distribution of the desert tortoise in the state of Nevada.

Soils that are frequently flooded could present obvious hazards to a burrowing animal.

These soil characteristics were applied to the soils in the seven map units in the survey area. The results are that map units with the highest ratings also have the highest densities of desert tortoise in the Puite Valley. Table 1 summarizes these soil properties.

While there are numerous indicated associations between vegetation and tortoise density, a more detailed study is needed to develop them. There may be a relationship between the highly productive and opportunistic introduced annuals such as filaree and Schismus barbatus and tortoise density. These are known to be part of their diets. Filaree is highly nutritious and has a high water content during its growth period and Schismus is highly drought tolerant, growing even on the driest years to offer a staple, though lower quality, food supply.

The desert tortoise spends approximately 90 percent of its life in a subterranean environment where the burrow protects it from the cold winters, hot summers, and predators. Since soils and their properties comprise the desert tortoise's subterranean environment and the vegetative community its surface environment, mapping the soil to soil series, determining their properties, correlating range sites and determining the existing vegetative community can assist the manager in understanding and managing the desert tortoise more effectively. It may even be possible to accurately predict their distribution and densities and develop a computer model to simulate various environmental conditions such and drought, grazing, or other factors.

A soil survey can be useful in providing preliminary interpretations for burrowing locations and potential plant community information relating to range condition or vegetative seral stages on the availability of forage and cover for the desert tortoise. Interpretations provided by a soil survey should only be used as part of an overall habitat evaluation for the desert tortoise.

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