Soil Data for Desert Tortoise Occupancy Covariate Monitoring
Boulder City Conservation Easement (BCCE)

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The last 27 million years…

According to fossil records the desert tortoise is one of four species that have remained virtually unchanged since the Oligocene Epoch (27-37 million years ago).

What was once a dominant and widespread family, 220 million years ago, is now an evolutionary relict.
This species was originally described “from the mountain of California, near Fort Mohave” (Cooper, Proc. Calif. Ac. Nat. Sc., II, p. 121), and the National Museum has since received specimens from Fort Yuma.

Dr. Cooper adds that “broken shells are frequent on the higher parts from the mountains west of the Colorado, where the Pah-Utes eat them.”

“The present expedition, therefore, not only extends the known range of this species considerably within California, but shows for the first time that it occurs in Nevada as well.”

Leonhard Stejneger, 1893
“This tortoise is remarkable among American species for its power of living in the arid deserts of the Lower Sonoran zone, far away from water. It is tolerably common in the Mohave Desert, California, where one was caught between Dagget and Pilot Knob, April 24, and another at Leach Point Valley April 25.

Two were found in Pahrump Valley, Nevada, where it is so much sought after by the Pah-Ute Indians and coyotes that it is rather scarce. At the Great Bend of the Colorado many unusually large shells about an old Indian encampment, where they had been left after the bodies have been eaten.”

C. Hart Merriam, 1893
Biological Opinion for Soil Survey

- Federal listing of desert tortoise April 2, 1990
- Request for consultation with USFWS August 20, 1991
- Approval January 14, 1992 for Clark County Soil Survey
- Conduct order 3 soil survey on ~3,000,000 acres of land
- Include all 14 tortoise management areas in Clark County
- Mapping of military installations in California begins 1994
Taxidea taxus
American badger

Burrowing barometer

Common sense, if a badger cannot dig through it, neither can a tortoise
NCSS standards are common or shared procedures that enhance technology transfer, data sharing, and communications among soil survey participants.

Recorded observations validate predictive models, the models project the expected behavior of similar soils from the behavior of observed soils.

The evaluation and updating of soil interpretations is dynamic. In cases where the physical, chemical, and morphological properties in the current official data have not changed, but new interpretations are needed, we are able to create new interpretive results from the existing current data.
The desert tortoise spends much of its long life (between 30 and 70 years) in burrows, emerging to feed and mate in the late winter or early spring.

Nests are often dug at the entrance of the burrow in early season, inside the burrow later in the season.

Temperature seems to be important in incubation (brumation):

- 79-87 degrees – all males;
- 88-91 degrees – all females

While in the burrows or caves, they reduce their metabolism and loss of water and consume very little food (National Wildlife Refuge System, 2000).
Soil Suitability for burrowing by Desert Tortoise

The soil is interpreted as a habitat component according to its potential to be used by desert tortoise in excavating burrows.

This interpretation guide is of a more general nature. It is designed to be used in the planning process to identify areas of concern prior to the application of conservation practices.

The final identification and selection of a site suitable for burrowing by desert tortoise is determined by the limitation of the soil as it influences excavation, maintenance, and preservation of the burrows.
Dust:

“Although amphibole minerals are common, fibrous and asbestiform amphiboles are less so and require specific geologic processes that promote the growth of fibers, in particular rock deformation during or subsequent to amphibole growth (Ahn and Buseck, 1991; Virta, 2002).”

These asbestiform forms are present in areas of alluvium deposited from erosional processes of these minerals in the Northern portion of Eldorado Valley. Buck et al., 2013
BCCE Soils Project

• Traverse method serves as a survey of the geomorphic surfaces in the BCCE

• 80 predetermined plots provided by DCP

• Plot sizes are 4 ha (200 m x 200 m)

• Active tortoise burrows were located in a previous study
Project Goals and Objectives

List of project objectives/tasks completed in 2013:

1. Estimation of soil series within each plot using traverse sampling method in each of the 80 predetermined plots

2. Determination of the soil series present at the 16 known active desert tortoise burrows in the 80 plots; and

3. Determination of exposed restrictive layer (i.e., petrocalcic, duripan) locations within each of the 80 plots via visual observation along traverses.
Soil Mapping Basics

• Map Units consist of…
  – Consociations, Associations and Complexes
  – Several series present in each

• Series
  – taxonomic unit of soil
  – describes a pedon

• Utilized NRCS Soil Maps as a starting point
Traverse Method

- Walked traverse lines at the 50, 100 and 150 meter locations along the side of the plot
  - walked either vertically or horizontally across the plot to maximize capture of the soil variability.

- Recorded GPS locations in the middle of each representative landform along the traverse

- Collected data at each Soil Observation Point
  - Slope, texture, photo, percent rock cover, flooding class
Types of GPS points

- Soil Observation Point
- Exposed Restrictive Features
- Soil pits
  - Pit = pedon
- Other points

Trimble Juno Device
Left: Surface rock cover photo

Below: Tortoise burrow under a hardpan in a wash
Pits at Active Burrows

• Distance of pit from burrow was 15 feet
  – 60 feet if located in the side of a wash

• If the pit did not match a known series, it was classified as “Other” and a small description was recorded
  – Texture, depth of horizon, effervescence, rock fragment modifier, any other useful data
Analyzing Data

- Informal cluster analysis
  - Group plots with same geomorphic surface
    - *e.g.*, fan remnant summit with incised washes
    - *e.g.*, fan apron material with washes
  - Compare photos, points, pit descriptions, vegetation changes and other changes across landscape
    - Usually have same vegetation
    - Usually do not have drastic changes in slope or water/moisture

- Characteristics of each plot should be consistent across the Group

- Identify and set aside outliers and transition zone plots
Plot Groups

- **South Section of BCCE**
  - Groups 1, 2, 3, 4, 5, 6, 7

- **North Section of BCCE**
  - Groups 8, 9, 10, 11

- **Individuals:**
  - Plots that don’t have similarities of any other nearby plots
  - Plots that are on transition zones and show characteristics of both Map Units
  - Plots that are the only sampling point in a particular Map Unit
North BCCE

- Shows groups of similar plots and the NRCS Soil Map boundary
South BCCE

- Shows groups of similar plots and the NRCS Soil Map boundary
Recommendations

• One pit could be fully described and characterized in an ideal location(s) in each Group
  – Ideal=ease of access, best representation of a dominant landform in that plot and representative of that landform in other plots

• Once series is determined at the suggested pit locations every plot in that Group can be associated with the field determined series

• Restrictive feature samples will help in determining taxonomy of unknown soils
  – Acid dissolutions required to determine the cementing agent
Conclusions

• Traverse sampling provides a good way to most efficiently determine pit locations
  
  – Allows for identification of problem areas
  
  – Saves time by limiting number of full pits
  
  – Can be tailored to a specific project/goals

• Aids in development of an accurate soil map as a component of the covariate analysis by DCP