12-1-2012

The impact of creosote bush (Larrea tridentata) and biological soil crust on Ca distribution in arid soils of the Mojave Desert

Brittany Myers
University of Nevada, Las Vegas, myersb8@unlv.nevada.edu

THE IMPACT OF CREOSOTE BUSH (*LARREA TRIDENTATA*) AND BIOLOGICAL SOIL CRUST ON CA DISTRIBUTION IN ARID SOILS OF THE MOJAVE DESERT

By

Brittany R. Myers

Bachelor of Arts
Albion College
2010

A thesis submitted in partial fulfillment
of the requirements for the

Master of Science in Geoscience

Department of Geoscience
College of Sciences
The Graduate College

University of Nevada, Las Vegas
December 2012

THE GRADUATE COLLEGE

We recommend the dissertation prepared under our supervision by

Brittany R. Myers

entitled

The Impact of Creosote Bush (*Larrea Tridentata*) and Biological Soil Crust on CA Distribution in Arid Soils of the Mojave Desert

be accepted in partial fulfillment of the requirements for the degree of

Master of Science in Geoscience
Department of Geoscience

Elisabeth Hausrath, Ph.D., Committee Chair

Brenda Buck, Ph.D., Committee Member

Matthew Lachniet, Ph.D., Committee Member

Dale Devitt, Ph.D., Graduate College Representative

Tom Piechota, Ph.D., Interim Vice President for Research &
Dean of the Graduate College

December 2012

ABSTRACT

The Impact of Creosote Bush (*Larrea tridentata*) and Biological Soil Crust on Ca Distribution in Arid Soils of the Mojave Desert

By

Brittany R. Myers

Dr. Elisabeth Hausrath, Examination Committee Chair
Assistant Professor of Geoscience
University of Nevada, Las Vegas

Ca is an important nutrient that plays a role in membrane stability and cell repair in plant life. This study examines the impact of creosote bush (Larrea tridentata) and biological soil crust on calcium cycling and distribution in desert soils in order to explore the use of Ca as a biosignature. Samples of creosote bush, biological soil crust and eolian dust were taken at two field sites in the Mojave Desert. The first site is located in Eldorado Valley, NV, a soil formed on a young (800-1200 years) alluvial fan deposit; the second site is located on a late Holocene-aged alluvial fan from the Lucy Gray Mountain Range in Ivanpah Valley, NV. Both sites are dominated by creosote bush, have a granitic parent material and contain biological soil crust. Soil and dust samples were subjected to three sequential extractions of $BaCl_2$, CH_3OOH, and HNO_3; creosote bush was digested with HNO_3. All solutions were analyzed for Ca content by flame AAS. Results show that soils in the rhizosphere also contain higher amounts of exchangeable Ca but lower amounts of $CaCO_3$, relative to soils at the same depth in the interspaces. Soil immediately beneath the biological soil crust is depleted in exchangeable Ca but shows no effect on $CaCO_3$ relative to the soils in the interspaces. These results may be useful for

identifying past vegetative life in desert paleosols in which this pattern of Ca is preserved.

Acknowledgements

I would like to express my sincere gratitude towards all of those who have helped me these past years, especially the NASA Nevada Space Grant Fellowship, the Bernada E. French Scholarship, and UNLV's Graduate and Professional Student Association for providing me with the funding necessary to complete this thesis.

Secondly, and probably most importantly, I would like to thank my advisor, Dr. Libby Hausrath, for her support and guidance, and her unwillingness to give up on me. Despite all circumstances, she has always pushed me to succeed and I am grateful.

I would like to thank my friends in the department, especially my officemates Julie Baumeister, Valerie Tu, Chris Adcock, and Seth Gainey for their overwhelming emotional and academic support. Another thank you I extend to my undergraduate friends and colleagues, Kirellos Sefein and Steven McDonnell, for their help in the laboratory. Their assistance has been invaluable.

Finally I would like to thank my family, especially my parents, and my significant other Nick Downs, for their unwavering love and support. To Mom and Dad, I'd love the chance to dedicate a best-selling novel to you, but since I am a scientist and a very poor fictional writer, this thesis will have to suffice.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 Introduction and Background

1.1 Introduction

Biosignatures, which provide evidence for past life, can be critical in interpreting climatic and biological activity. Biosignatures can occur in many forms, including microbial biosignatures such as body fossils, stromatalites, trace fossils, reduced or oxidized minerals, alteration of geochemical cycles, fractionation of stable isotopes, chirality, metabolic byproducts, and organic molecules (Fisk et al., 2006). Mineralogical biosignatures, a particular category of biosignatures, indicate past life and occur in the form of minerals that have been produced by microbial metabolic processes, minerals associated with organic polymers, and alterations to minerals or their distributional patterns by biota (Banfield et al., 2001). These mineralogical biosignatures are particularly important in the absence of organic remains.

Biosignatures are often preserved in paleosols, or fossil soils that are no longer interacting with the current landscape. Multiple researchers have used biosignatures found in paleosols to interpret past life. For example, Hembree and Hasiotis (2008) used trace fossils preserved in Miocene paleosols to gain a better understanding of past ecosystems. A study by Ohmoto (1996) interpreted reductive dissolution of ferric hydroxides found in paleosols as evidence for organic acid release by terrestrial biomass, and Sedov et al. (2003) have used stable carbon isotope ratios from paleosols to infer paleovegetation.

Because they have received minimal rainfall, paleosols from desert environments are able to preserve distinct pedogenic features. These features, which may be subject to dissolution under normal conditions, are preserved in drier environments. Nettleton et al. (2000) define paleoaridisols as paleosols that have a petrocalcic or petrogypsic horizon, a vesicular (av) horizon at the surface, flocculated argillans or papules in the B horizon, or desert pavement at the surface. Buck and Mack (1995) used carbonate and argillic horizons as well as carbonate nodules and tubules to identify paleosols as having been formed in an arid environment. An arid paleosol will allow the preservation of these features while soil from a wetter environment may not.

Research has shown that carbonate features are often well preserved in desert paleosols (Nettleton et al., 2000; Rech et al 2006), and therefore the biological impacts preserved in carbonates may be useful as a biosignature. The goal of this study, therefore, was to quantify biological impacts on Ca distribution by creosote bush and biological soil crusts. Specifically, we aimed to test the hypothesis that creosote bush and biological soil crust have a measurable effect on calcium distribution in desert soils, which may be usable as a biosignature for biota in paleosols from arid environments.

1.2 Background

Calcium, on which this study is focused, is a nutrient required in plants, including creosote bush, for processes such as cell wall and membrane stability (Kirkby and Pilbeam, 1984). Preservation of $CaCO_3$ in desert soils may allow the preservation of a Ca biosignature of past biota. $CaCO_3$ in desert soils is precipitated during pedogenesis, and ranges in quantity from a light coating of the soil grains to a layer of hard, cemented pedogenic calcrete. Six stages of carbonate morphology have been identified by Gile et al. (1966) and Bachman and Machette (1977). The amount of carbonate increases from stage I to stage VI over timescales ranging from less than 2,600 years to over 890,000 years (Gile et al., 1966; Bachman and Machette, 1977; House et al., 2010). Therefore, an older aridisol will typically yield greater amounts of pedogenic carbonate than a younger soil.

Changes in precipitation can change the depth of pedogenic carbonate precipitation over time. An increase in effective precipitation can cause the zone of $CaCO_3$ precipitation to move to greater depths or cause dissolution of $CaCO_3$, while an increase in aridity can cause a shallowing of the pedogenic carbonate (Jenny, 1941; Mayer et al., 1988; Retallack, 2005). $CaCO_3$ deposition is increased by the removal of soil water, leading to precipitation during seasonal droughts (Schlesinger, 1985). Deposition is slowed by root activity such as the production of CO_2 (Marion et al., 1985), which takes place when higher levels of moisture are available.

The source of $CaCO_3$ in desert soils is primarily $CaCO_3$-rich eolian material (Reheis et al., 1992; Reheis et al., 1995; Capo and Chadwick, 1999). Fine dust particles are deposited at the surface, typically during a rainfall event, a change in wind velocity, or by capture by surface features (Tsoar and Pye, 1987) and then dissolved and transported to depth by percolating water. This process occurs by the following reactions, in which CO_2 (carbon dioxide) is derived from the atmosphere:

$$CO_{2(g)} + H_2O_{(aq)} \rightarrow H_2CO_3$$

$$CaCO_{3(s)} + H_2CO_{3(aq)} \rightarrow Ca^{2+}_{(aq)} + 2HCO_{3(aq)}$$

The Ca^{2+} ions are transported downward in solution; a decrease in soil moisture, an increase in pH, a decrease in CO_2 pressure, or an increase in the concentration of Ca^{2+} ions will cause the $CaCO_3$ to precipitate as shown below:

$$2HCO_{3(aq)} + Ca^{2+}_{(aq)} \rightarrow H_2CO_{3(aq)} + CaCO_{3(s)}$$

In southern Nevada and California, playas and alluvial fans and alluvial plains are a major source of dust (Reheis et al., 1995). Recent fluvial or pluvial processes in source environments separate fine particles from larger soil particles, making the fine particles more subject to wind erosion (Prospero et al., 2002). Evaporation of water from playas produces evaporite minerals, including $CaCO_3$, $CaSO_4 \cdot 2H_2O$, NaCl, and Na_2SO_4, at the playa surface that are then susceptible to transport due to their loose aggregation and high pore space volume (Reynolds et al., 2007; Reynolds et al., 2009). Reheis and Kihl (1995) have suggested that larger proportions of dust in southern Nevada and California originate from alluvium than playas, however, due to their greater surface area cover in this region.

Dust deposition is strongly impacted by land surface characteristics. Some studies (Coppinger et al., 1991; Su et al., 2004; Dong et al., 2009) suggest that the capture of windblown material by desert shrub canopies contributes to the higher concentrations of nutrients beneath the shrubs. Soils beneath desert shrubs have high concentrations of soil nutrients, such as N, PO_4, Cl, SO_4, and K (Charley and West, 1975; Schlesinger et al., 1996), whereas adjacent interspaces have higher concentrations of Ca, Mg, Na, Rb, Li, and Sr. This increase in nutrients beneath desert shrubs as compared to the interspaces between shrubs is known as “islands of fertility” (Gerakis and Tsangarakis, 1970; Charley and West, 1975; Crawford and

Gosz, 1982; Schlesinger et al., 1996; Ridolfi et al., 2008). Additional biotic and abiotic processes have been proposed to increase the nutrients beneath desert shrubs, including the deposition of leaf litter (Schlesinger and Pilmanis, 1998), differences in infiltration due to differences in texture and organic matter (Titus et al., 2002), differential rainsplash (a process by which rainsplash transports material underneath shrubs where it is then trapped) (Parsons et al., 1992), transport of nutrients to the shrub from the interspaces by the roots (Caldwell et al., 1998; Gutiérrez et al., 2006), and contributions from rodent mounds (Chew and Whitford, 1992; Titus et al., 2002).

Areas beneath plant canopies also sometimes have lower pH values than the interspaces (Charley and West, 1975). Under plant canopies, vegetation has a strong impact on soil pH. Laboratory studies by Bravin et al. (2009) and Blossfeld et al. (2010), on plants including wheat, maize, alpine pennycress, and ryegrass found that the pH of the rhizosphere, or soil zone influenced by plant roots, differs depending on plant species. Additionally, research in the Mojave Desert has shown that plant interspaces typically have a higher pH than the area beneath plant canopies (Romney et al., 1980). The degradation of organic matter, which is found in the highest amounts underneath plant canopies in desert environments, causes a release of CO_2 (Bolin, 1977; Schlesinger, 1984; Borken et al., 2002). In the rhizosphere, plants can alter the soil pH by the release of OH^-, HCO_3^-, or H^+ from their roots during nutrient uptake in order to maintain a charge balance, depending on the charge of the needed nutrients (Nye, 1981; Haynes, 1990; Hinsinger et al., 2003).

In addition to the efflux of these ions, release of organic acids by plant roots can also lower pH in the rhizosphere (Hoffland et al., 1989; Haynes, 1990; Drever and Stillings, 1997; Hinsinger et al., 2003). Organic acids can affect soils in multiple ways, including aiding in the dissolution of minerals (Jones, 1998; Hausrath et al., 2009) and the mobilization of nutrients such as P, Ca, Mg, Mn, and Fe in the soil (Jones and Darrah, 1994; Jones, 1998).

Creosote bush (*Larrea tridentata*) is one of the most common and widespread plant species in the lower elevations of the deserts of North America (Benson and Darrow, 1981). *L. tridentata* is a species of particular interest for determining biosignatures because of its ability to exist in an area for long periods of time. The desert shrub grows by cloning, creating a ring of genetically identical individuals surrounding the original plant (Vasek, 1980). These clonal colonies have been recorded to live up to 10,000 years (Vasek, 1980). According to packrat midden data, the creosote bush, along with other modern vegetation, began to become widespread in the Mojave Desert approximately 6,000 years ago with the transition from a wet to an arid climate during the early Holocene(Koehler, 2005).

Like many other desert plants, the roots of the creosote bush have a lateral projection rather than a vertical one (Chew and Chew, 1965; Wallace et al., 1981). Wallace et al. (1981) excavated several *Larrea* individuals from the Mojave Desert to determine the root distribution at depth and found that most of the larger roots extended 0-30 cm below the surface and most of the fine roots were found in the 10 cm to 30 cm depth range. 97% of the roots were found at depths shallower than 40 cm, and Wallace and colleagues (1981) did not observe *Larrea* roots below 50 cm.

The shallow extent of the roots of *L. tridentata* is due to the shallow infiltration depth of water in arid regions (Schenk and Jackson, 2002) and the presence of pedogenic calcrete in some instances (Wallace et al., 1981).

Using its extensive root system, *Larrea tridentata* can access water and nutrient resources from further distances compared to several other Mojave Desert shrubs, including *Lycium andersonii* (Anderson boxthorn), *Abrosia dumosa* (white bursage), and *Lycium pallidum* (pale desert-thorn) (Hartle et al., 2006). This is critical, as moisture is an important limiting factor in desert environments (Fonteyn and Mahall, 1978).

The interspaces between desert shrubs are strongly impacted by biological soil crusts (BSCs). Biological soil crusts are biosedimentary structures that live in or on the top several millimeters of soil (Evans and Johansen, 1999; Belnap and Lange, 2001). BSCs are made up primarily of cyanobacteria, but can include mosses, algae, fungi, lichens, and/or bryophytes (Belnap and Lange, 2001). BSCs have previously been studied for their ability to increase water infiltration and decrease runoff, to stabilize and prevent soil erosion, to capture dust and enhance nutrient availability, to contribute to the formation of Av horizons, and their role in soil fertility by aiding in nitrogen fixation (Belnap and Lange, 2001; Williams et al., 2012). According to Warren (2001), the presence of BSCs can effectively reduce soil erosion by water depending on the soil texture. BSCs are also known for their ability to prevent wind erosion by increasing soil stability (Belnap and Gillette, 1998). Cyanobacteria bind to the land surface by attaching polysaccharide sheaths to soil grains, thereby increasing the stability of the soil (Fletcher and Martin, 1948; Belnap and Gardener, 1993; Evans and Johansen, 1999), though this is only possible when the BSCs are left undisturbed (Belnap and Gillette, 1998).

In several studies, the presence of BSCs has been shown to alter the nutrient levels of surrounding plants. BSCs encourage the growth of surrounding vascular plants by nitrogen fixation, in which the crust converts atmospheric nitrogen to ammonia (Shields and Durrell, 1964; Evans and Johansen, 1999), and have been shown to increase the nitrogen levels of surrounding plants (Mayland and McIntosh, 1966; Harper and Pendleton, 1993; Belnap, 1996). Bernaldi-Campesi et al. (2009) studied elements (C, N, P, S, Mg, Al, Ca, V, Cr, Mn, Fe, As, Rb, and Pb) in BSCs, soil directly (1 cm) beneath the crust, and non-crusted soil within 1 cm of the surface, and found a reduction of all elements in soil beneath the BSCs. The authors interpret these results as indicating that these elements have been leached further downward than the immediate subsurface of the soil, and eventually are transported away from the BSCs and become available as nutrients for vascular plants.

If the differences in soil properties that are caused by biological soil crusts are preserved in paleosols, they could be used as biosignatures. Some studies have used BSCs as analogues for ancient microbial communities. Campbell (1979) used BSCs to help understand the role of ancient microbial communities in the formation of Precambrian soils, while Dott (2003) used biological soil crusts to understand how microbial communities of the past may have stabilized Paleozoic surfaces. Differences in Ca distribution caused by biological soil crust may therefore prove to be a useful biosignatures within paleosols.

Numerous studies have used paleosols to interpret the past, including inferring the presence of biota (Ohmoto, 1996; Hembree and Hasiotis, 2008), sequence stratigraphy and landscape paleosurfaces (Kraus, 1999), and levels of atmospheric O_2 (Prasad and Roscoe, 1996; Ohmoto, 1996; Utsunomiya, 2003). Paleosols have also been used to analyze various paleoecological and paleoclimatic indicators including clays (Singer, 1980), organic matter (Sedov et al., 2003), and carbonates (Cerling, 1984; Cerling and Hay, 1986; Cerling et al., 1989) for C-isotope content. The C isotopes have been interpreted as a record of the local soil CO_2 (Cerling, 1991), which is produced in the soil by root respiration, root decay and leaf litter of plants (Edwards and Harris, 1977; Haynes and Gower, 1995; Amundson et al., 1998).

Desert paleosols have also been used by researchers to interpret regional climatic changes. For example, Rech et al (2006), used the presence of morphological features and salt chemistry in paleosols to reconstruct the climate history in the Atacama Desert, Chile. It could be observed from the paleosol that the soil had changed from a calcic vertisol (20 Ma) to a salic gypsisol, having experienced a gradual drying of the climate between 19 and 13 Ma (Rech et al., 2006). Similarly, Jiamao et al. (1997) used paleosol carbonates to reconstruct the paleoenvironment of the Loess Plateau in north central China. Using the O and C isotopic compositions of the carbonates, workers were able to determine the past humidity and temperature of the region. These studies show that paleoaridisols preserve carbonates over long periods of time, providing scientists useful insights to the desert's past.

Therefore, in order to interpret the potential for calcium as a signature for biological impacts, this study focuses on the influence of *L. tridentata* and biological soil crusts on patterns of Ca distribution in Mojave Desert soils. Samples of soil from underneath creosote bush and biological soil crusts were collected and compared to interspace and non-crusted soils respectively. The soil samples were analyzed for Ca content and used to determine the effects of vegetation on soil Ca concentrations.

2.0 Field Area

2.1 Eldorado Valley

This study took place at two field sites in the Mojave Desert of southern Nevada. The Eldorado Valley field site is located in the northern end of Eldorado Valley at approximately 35°56'13"N, 114°153'56"W on the alluvial fan of Black Hill (Fig 1). Eldorado Valley is a topographically closed basin that lies approximately 35 km southeast of Las Vegas, Nevada, just east of Black Hill and the McCullough Mountain Range and west of the Eldorado Mountains (Longwell et al., 1965). Elevations in the Eldorado Valley range from 2152 m at McCullough Mountain to 521m at the central valley floor (DOE, 1996). Eldorado Valley is in the arid Mojave Desert, and it averaged an annual amount of precipitation of 41.10 cm from the years 1931 to 2005 (WRCC, 2012). The wettest month of the year is August, with an average precipitation of 1.80 cm, and the driest month is May, with an average precipitation of 0.46 cm (WRCC, 2012). Vegetation that thrives in this environment is well-adapted to the limited moisture, and creosote bush (*Larrea tridentata*) is the dominant species (Benson and Darrow, 1981).

The Eldorado Mountains to the east of the valley contains outcroppings of Cretaceous and Tertiary granodiorite and quartz monzonite. Volcanic rocks dominate the Eldorado Mountains as well as the northern end of the McCullough Mountains (Longwell et al., 1965). These rocks are thought to make up the basement rocks in the Valley (DOE, 1996), and likely contribute to the composition of the valley soils. Some sedimentary rocks, such as sandstone, siltstone, and clay, present in the Muddy Creek Formation, are found in northern Eldorado Valley, lying approximately 12 km from the field site.

Soils at Eldorado Valley are dominantly affected by abiotic processes, and are described as massive with little development and structure, no horizonation, and have a fine sandy texture at the surface that coarsens with depth (Young et al., 2009; Nie, 2009; Nie, in prep). In addition, no vertical cracks or clay alteration were observed (Nie, in prep). The soil at Eldorado Valley lacks petrocalcic development near the surface, and development is found only below approximately 200 cm (Nie, in prep; Young et al., 2009). The lack of soil development is consistent with the young age of the soil, which is estimated to be between 800-1200 years old (Doug Merkler, pers. comm. with Wenming Nie). The amount of gravel (particle diameter >2mm) varies between bars and swales at the field site; bar sites have better sorting of clast sizes and contained less gravel-sized clasts and more sand-sized clasts than swale sites.

2.2 Lucy Gray Alluvial Fan

The Lucy Gray site is located just east of the Lucy Gray Mountain Range and west of the southern end of the McCullough Mountains in Ivanpah Valley at approximately 35°40’35”N, 115°16’26”W (Fig 1). The field site lies 50 km south of Las Vegas, Nevada near the California border. Both the Eldorado Valley site and the Lucy Gray field site lie on alluvial fans composed of Quaternary alluvium, and experience a similar arid climate, although the Lucy Gray site is situated at a slightly higher elevation than Eldorado Valley at approximately 1105 m. A wider variety of vegetation species is seen at this site, though *L. tridentata* still dominates.

The Lucy Gray Mountains and the Southern end of the McCullough Mountains are composed of Proterozoic-aged intrusive and metamorphic rocks such as granite, gneiss and quartz monzonite (House et al., 2006; 2010). Some younger volcanic units are also present in the southeastern part of the Lucy Gray Range, having compositions varying from basalt to rhyolite. Like Eldorado Valley, some sedimentary lithologies are present near the Lucy Gray field area: limestones and dolomites are found approximately 9 km north of the field site at Sheep Mountain (Longwell et al., 1964).

Soils at the Lucy Gray field site consist of crudely- to moderately-stratified, coarse grained, sub-angular, sandy alluvial fan gravel deposits derived from the nearby Lucy Gray Mountains (House et al., 2010). Soils are poorly-to-moderately sorted and have a gravely and sandy texture (House et al., 2010). Bar and swale morphology is more pronounced at the Lucy Gray site than at the Eldorado Valley site. Minimal petrocalcic development is found in the soils; carbonate coatings are found on clasts within the bk (carbonate) horizon, which lies below the Av (vesicular horizon) (House et al., 2010). Surficial soils are estimated to be no older than 4,500 years old (House et al., 2010).

3.0 Methods

3.1 Sample Collection

Samples of soil, biological soil crust, eolian dust, and creosote bush were collected at both the Eldorado Valley and the Lucy Gray alluvial fan field sites. Sampling took place at the Eldorado Valley site in both late May and late September; sampling took place at the Lucy Gray site in both early June and late October. No precipitation occurred at the sampling sites during the days sampling took place; however, a light precipitation event had occurred in Eldorado Valley within 24 hours of the September sampling event, which may have affected the water content results of the soil.

Bar-and-swale morphology was observed at both field sites. A study by Nie (2009) showed that the distribution of chloride in desert soils was impacted by runoff from bars to swales. Samples from this study were all taken on morphologic bars to minimize aqueous processes occurring due to the microtopography of the area.

Soil sampling methods were designed to be similar to the methods of Li et al. (2011), who sampled soil at the rhizosphere scale, root system scale, and individual plant scale. Collection of the soil samples in our study took place at two scales: the rhizosphere and near-root scale (0-5 and 5-10 cm around the taproot) and the individual plant scale (10-100 cm from the shrub). Six creosote bushes were sampled, including three at Eldorado Valley and three at Lucy Gray. In this study, we have termed the 0-5 cm distance the “rhizosphere,” because it includes the rhizosphere, and the 5-10 cm distance the “near-root”.

To sample the soil at the rhizosphere and near-root soil, a small soil pit was dug directly underneath the creosote bush to the depth at which the creosote roots began to extend laterally, which was approximately 20-30 cm. Soil samples were collected around the taproot from rhizosphere and near-root scales at 5 cm depth intervals to a depth of 20 cm. Soil from around two primary roots of each shrub was sampled, with the exception of Lucy Gray creosote bush 1, in which soil around three roots was sampled. Additionally, because of the specific root distribution of Lucy Gray creosote bush 1, some rhizosphere samples were taken at depth intervals different from the other 5 shrubs.

To sample at the scale of the individual shrub, a 1 m long trench was dug from the crown of the plant extending away from the creosote bush into the plant interspace. These samples are termed “interspace samples” because they showed statistically significant differences from the samples closer to the root in pH and Ca content. Major roots of the creosote bush and other creosote bush individuals, which were spaced approximately 2-3 m apart, were also avoided when sampling at this scale. Samples were collected at three distances of 10, 50, and 100 cm from the shrub. At each distance from the plant, samples were collected at 5 cm depth intervals, similar to the sampling methods in the rhizosphere and near-root, to a depth of 60 cm. Creosote bush C-1 at the Lucy Gray field site was an exception, in which sampling below a depth of 40 cm was obstructed by the presence of a large rock. 50-100 g of soil was collected at each distance and depth interval to perform sequential extractions, x-ray diffraction, and optical analysis.

Soil samples were also collected from beneath 3 biological soil crusts at each site, as well as 3 samples of adjacent non-crusted surface soil. Soil from approximately 1 cm below each biological soil crust was excavated similar to the methods of Bernaldi-Campesi (2009). The uncrusted soil within a few cm of each biological soil crust was sampled from a depth of approximately 1 cm below the surface.

Samples of *L. tridentata* itself were also collected so that Ca concentrations in the plant tissue could be determined. Samples of foliage, stemwood, and roots were removed from each of the three creosote bushes from each site for digestion. Each creosote bush sampled was also measured for length, width, and height in order to calculate biomass (Table 27).

Although the focus of this study is to quantify the Ca concentration of the soil, samples of eolian dust were also collected at each field site to measure the Ca content for comparison to the soil. Four dust traps were emplaced at each site for 1-2 months to collect eolian dust. Each dust trap consisted of a 22.5 cm diameter plastic disk filled with two superimposed layers of acid washed glass marbles, which were 1.6 cm in diameter. Two collectors were placed underneath creosote canopies and two collectors were situated in plant interspaces at each of the two field sites. A dry marble collector was chosen for this study to avoid contamination of the dust with water, which can occur with wet collectors (Goossens and Offer, 1994).

3.2 Soil Color, pH, Water Content, and Electrical Conductance

In the laboratory, measurements of soil color, pH, water content, and electrical conductance were taken on each soil sample. Soil color was measured on field-wet soil samples using Munsell soil color classifications. Soil pH was determined by adding 2 mL of DI water to 1 g of field-wet soil and measuring the pH of the slurry (Brady and Weil, 2002). To measure moisture content, the field-wet soil was sieved to remove any grains larger than coarse sand (2 mm), weighed, oven-dried at 50°C for 48 hours (Hausrath et al., 2011), and then re-weighed. Water content of the soil samples was calculated as the soil wet weight minus the dry weight divided by the dry weight and is reported as g water/ 100 g dry soil. Electrical conductance measurements were determined on oven-dried soil samples, using a 1:5 DI water-to-soil ratio similar to Li et al. (2011) to create a soil slurry mixture.

3.3 Soil and Plant Digestions

3.3.1 Sequential Extractions

Soil and dust samples were subjected to three sequential extractions to determine the Ca present in the exchangeable and salt fraction (0.1 N $BaCl_2$), carbonates (4 N CH_3COOH), and Ca present in other accessible materials (1 N HNO_3). One gram of oven-dried soil or dust was first extracted with 10 ml of a 0.1 N $BaCl_2$ solution adjusted to pH = 8 with ultrapure NH_4OH to prevent the dissolution of carbonates. The $BaCl_2$ solution extracts soluble salts and exchangeable cations, including Ca (Holmden and Bélanger, 2010). The $BaCl_2$ extraction was followed by a 4 N CH_3COOH extraction to preferentially dissolve the carbonate (Jacobson and Holmden, 2006), and an extraction of 10 ml of 1 N HNO_3, to remove Ca by dissolution of remaining minerals, such as apatite (Nezat et al., 2007). However, because the final extraction of HNO_3 did not completely dissolve the material, nor is likely to be as accessible to biota as the exchangeable and carbonate fraction, these results were not used in further analyses. For each extraction, samples were agitated on a shake plate at approximately 25° C for two hours at 100 rotations per minute (RPM), and were then centrifuged at a speed of 2500 RPM for 20 minutes (Jacobson et al., 2002). Each solution was then decanted and filtered (0.45μm polypropylene filter) into acid-washed LDPE bottles. All solutions were acidified to 1% (v/v) with ultrapure concentrated HNO_3, and stored at 4°C until analysis.

Sequential extractions were performed at 5 cm depth intervals on samples from all three interspace distances (10 cm, 50 cm, and 100 cm), as well as rhizosphere and near-root samples, from the first creosote bush from each field site. Based on results from the first creosote bushes, at subsequent creosote bushes, sequential extractions were performed on every other sample (10 cm depth intervals) from 2 interspace distances (10 cm from the plant and 100 cm) and on only rhizosphere soils samples and not near-root samples (Appendix D). Because near-root soil samples and interspace soil samples at 50 cm from the plant were only analyzed from the first two creosote bushes, they are not used in final t-test statistical analyses.

3.3.2 Creosote Bush Digestions

The digestion of the plant material closely followed the procedure outlined in Holmden and Bélanger (2010). Samples of creosote foliage, stems, and taproots were separated and rinsed in DI water to remove dust or soil matter and air-dried at room temperature (22-25°C). One g of foliage, stem, or taproot material was then digested in enough ultrapure HNO_3 to completely submerge the sample in a 250 ml polytetrafluoroethylene (PTFE) beaker. The beakers were covered with PTFE watch glasses and heated at 110° C to ensure that the HNO_3 did not reach its boiling point of 120.5°C. Samples remained in the HNO_3 for a period ranging from 3-10 days until the plant matter was completely digested.

After the plant material was completely digested, solutions were filtered with 0.45 μm polypropylene filters and decanted into 250 ml low-density polyethylene (LDPE) bottles. In some cases, digestions were centrifuged at 12,500 rcf before filtration.

3.4 Analyses

All solutions were diluted with 18.2 MΩ deionized water, and a solution of 0.36 M $LaCl_3$ added to 10% v/v to mitigate interference before analysis by Atomic Absorption Spectroscopy (AAS), using a Thermo Scientific iCE 3000 series Atomic Absorption Spectrometer. Four soil samples, one shallow sample (sample depth of 0-5 cm) and one deep sample (sample depth of 55-60 cm) from each field site as well as one rock sample from the Lucy Gray site were analyzed for bulk mineralogy by powder X-ray diffraction using a PANalytical X'PERT Pro X-ray Diffraction at the XRD/XRF Laboratory at UNLV. Soil samples were also viewed optically for visible $CaCO_3$ coatings on grains.

3.5 Statistical Analyses

To test our hypothesis that creosote bush and biological soil crusts can significantly impact Ca concentrations, we performed one-tailed paired t-tests to compare the following: rhizosphere samples with interspace samples at the same depth and biological soil crust samples with interspace soil samples collected as described in the methods. The paired t-test is used to compare differences between samples that have a natural pairing, in this case with and without biota. Pairs consisted of the average of two rhizosphere soils collected 0-5 cm from the root paired with the 10 cm and 100 cm distance interspace soil samples at the same depths, and soil collected directly underneath the biological soil crusts paired with soil samples collected adjacent to the crusts. Only samples that fell into paired depth intervals were used for statistical analyses. Prior to the one-tailed t-tests, two-tailed tests were performed between the two rhizosphere roots of each creosote bush to ensure that there was not a significant difference between the roots (Tables 1-5). A one-tailed test was used to determine if one group had significantly different values than the other, while a two-tailed test was used to verify that two groups were not significantly different from one another. One-tailed paired t-tests were performed on all measured data parameters for creosote bush soil samples, including pH, electrical conductance, water content, calcium concentrations from the exchangeable fraction, $CaCO_3$, and the summed exchangeable and $CaCO_3$ concentrations. T-tests were performed at a significance level of 0.05 and did not include the preliminary samples discussed above.

Sample size for paired soils from underneath creosote bushes and the interspaces was 24 for statistical tests of pH, electrical conductance, and water content, and 14 for tests of exchangeable Ca and $CaCO_3$. Sample size for paired soils from underneath and adjacent to biological soil crusts was 6. All t-tests were done on small sample sizes in which the data showed a normal distribution. Normal distribution was determined by plotting ordered paired difference values against normal scores from Weiss (2008) to obtain a roughly linear distribution.

Spearman rank correlation was performed on measured variables pH, electrical conductance, water content, exchangeable Ca, and $CaCO_3$ in order to determine if they varied with depth for soil sampled from close to the creosote bushes and interspaces (Appendices F-J). Spearman rank correlation is used in paired data to determine whether the two variables co-vary. The sign of the Spearman's rho value is the indicator of a positive or negative relationship between the two variables. If Spearman's rho is equal to zero, then no correlation exists; if Spearman's rho is equal to 1 or -1, then a perfect monotonic relationship exists.

4.0 Results

Significant differences were found in both exchangeable Ca and $CaCO_3$ between rhizosphere soils and interspace soils, while soil sampled from beneath biological soil crusts showed significant differences in only exchangeable Ca compared to non-crusted soils. Soil properties including pH and electrical conductance showed statistically significant differences due to proximity to the creosote bush or BSC. Although soil samples were collected from both 0-5 and 5-10 cm around the plants' primary taproots, no significant difference in amount of Ca was observed between near-root soil samples and interspace samples (Table 6). Therefore because the near-root samples do not differ significantly in Ca content from the interspace, they are not considered further.

4.1 Soil Color, pH, Water Content, and Electrical Conductance

Soil color, pH, electrical conductance (EC), and water content were measured for all soils from the rhizosphere and the plant interspaces for each of the six shrubs sampled (Appendix C). The majority of all soils from both field sites were yellowish brown in color (Munsell color = 10 YR 5/4), but other soil colors observed included pale brown (10 YR 6/3), brown (10 Yr 5/3), light yellowish brown (10 YR 6/4), and dark yellowish brown (10 YR 4/4) (Appendix C). One-tailed paired t-tests of soil samples show that at both field sites, the pH of the soil from the rhizosphere is significantly lower than soils from both the 10 cm interspace distance (average difference = 0.23) and the 100 cm interspace distance (average difference = 0.30) (Figs 2 and 3; Tables 7 and 8). Results of the Spearman rank correlation test showed that for all six creosote bushes sampled, soil pH increases with depth. Electrical conductance is significantly higher in the rhizosphere soils than soils from the 100 cm distance (average difference =34.8 µsiemens), although no difference is seen between rhizosphere soils and soils from 10 cm from the creosote bush (average difference = 5.9 µsiemens) (Figs 4 and 5; Tables 9 and 10). A trend of decreasing electrical conductance with increasing depth is also seen (Figs 4 and 5) in four out of the six creosote bushes sampled. No significant differences are found in soil water content between the rhizosphere and either the 10 cm (average difference = 0.063 g water/100 g dry soil) or 100 cm (average difference = 0.046 g water/100 g dry soil) interspace distances (Tables 11 and 12), however, for four out of the six plants sampled, an increase in water content is seen with depth (Figs 6 and 7).

In order to further understand the impact of the creosote bush at the plant scale, two-tailed paired t-tests were also performed between the 10 and 100 cm interspace distances. Results showed that the two interspace distances showed no significant different in soil pH values (average difference = 0.07) (Table 13) or water content (average difference = 0.018 g water/100 g dry soil) (Table 14), but that the electrical conductance of the soil from the 10 cm interspace distance was significantly higher than that of the soil from the 100 cm interspace distance (average difference = 28.89 µsiemens) (Table 15). This suggests that the area of increased electrical conductance near the creosote bush extends to at least 10 cm.

4.2 Soil and Plant Digestions

4.2.1 Soil

One-tailed paired t-tests that were performed on soil collected from the rhizosphere and the interspace at 10 and 100 cm distances from the shrub indicate that soils from the rhizosphere had significantly more calcium from the exchangeable fraction than at both the 10 cm interspace distance (average difference = 0.003 mmol Ca/ g soil) and the 100 cm interspace distance (average difference = 0.004 mmol Ca/g soil) (Figs 8 and 9; Tables 16 and 17). Results from the Spearman rank correlation show a decrease in exchangeable Ca with increasing depth in five out of the six creosote bushes sampled. In contrast, significantly less carbonate is present in the soil from the rhizosphere than in soil from the 10 cm (average = 0.0016 weight % $CaCO_3$) and 100 cm (average difference = 0.0016 weight % $CaCO_3$) interspace distances (Figs 10 and 11; Tables 18 and 19), and $CaCO_3$ increases with depth for five out of the six plants. Two-tailed test results on the Ca from the exchangeable fraction and $CaCO_3$ between the 10 cm and 100 cm distances showed that the amounts of exchangeable Ca (average difference = 0.0009 mmol Ca/g soil) and $CaCO_3$ (average difference = 0.0007 weight % $CaCO_3$) at the two interspace distances did not vary significantly (Tables 20 and 21). Results from the t-tests in which calcium from the exchangeable fraction and from $CaCO_3$ were added together show that amounts of Ca in the rhizosphere are not significantly different from the 10 cm interspace (average difference = 0.013 mmol Ca/ g soil) or the 100 cm interspace (average difference = 0.019 mmol Ca/ g soil) (Tables 22 and 23).

4.2.2 Biological Soil Crust

Soils collected from the non-crusted soil surfaces contained a significantly higher amount of exchangeable Ca than the crusted adjacent soils (average difference = 0.018 mmol Ca/ g soil) (Table 24). In contrast, no significant difference in $CaCO_3$ concentrations was observed between soil from underneath biological soil crusts and soil from non-crusted surface soil (average difference = 0.0007 weight % $CaCO_3$) (Table 25).

4.2.3 Dust

Dust collected from underneath shrub canopies from both field sites had higher amounts of exchangeable Ca than dust collected from interspaces and are similar to those of rhizosphere soils. However, these samples contained high amounts of organic matter and may not accurately represent eolian influx. Dust collected in the interspaces had exchangeable Ca and $CaCO_3$ concentrations comparable to bulk surface soil (Table 26; Appendix E).

4.2.4 Creosote Bush

Calcium concentrations of creosote bush root, stem, and foliage tissue varied between tissue types. Creosote leaves contained an average of 0.032 mmol Ca/ g foliage, creosote stems contained an average of 0.023 mmol Ca/ g stem wood, and creosote roots contained 0.041 mmol Ca/ g root material. Estimations of biomass were used to estimate total Ca present within the creosote bush (Table 28), using equations for biomass by Ludwig and Reynolds (1975).

Average total moles of Ca in each creosote bush were calculated using measured Ca concentrations and previous calculations of biomass present in a creosote bush of given measured size. Creosote biomass was calculated from Ludwig and Reynolds (1975), in which the creosote volume was estimated as the volume for an inverted cone, using the expression

where V is canopy volume in m^3, r is the radius of the bush in m, and h is the height in m (Table 27). Measured width and length were averaged for the radius. Using equations from Ludwig and Reynolds (1975), the biomass of foliage, stem, and root tissues was calculated using the volume of the shrub with the expressions

$$B(\text{leaves}) = [illegible]V$$

$$B(\text{live stems}) = [illegible]V$$

$$B(\text{dead stems}) = [illegible]V$$

$$B(\text{roots}) = [illegible]V$$

where B is the biomass of the plant in g (Table 28). For this study, the assumption was made that Ca in live stem material was equal to the Ca in dead stems.

Moles of exchangeable Ca in the rhizosphere were estimated from the volume of a cylinder with a radius of 5 cm, which was the rhizosphere sampling radius around the root, and a length of 1.5 m. The average length of a creosote bush taproot has been measured as greater than 2 m (Gibbens and Lenz, 2001) and 1.5–2m (Briones et al, 1996); the smaller length of 1.5 m was used in this study as a likely minimum. The volume of the soil in the rhizosphere from which Ca is expected to be taken up was calculated using the expression

$$V = \pi r^2 h$$

in which V is the volume of the cylinder in cm, r is the sampling radius around the root in cm, and h is the height, or length of the root in cm (Table 29). In order to compare the rhizosphere soil exchangeable Ca to the Ca in the creosote bush, soil density of 1.71 g/cm^3 (Nie, 2009) was used to calculate the mass of the soil in the rhizosphere. The equation used can be seen below:

$$m = V\rho$$

in which m is the mass of the soil in g, V is the volume of soil in the rhizosphere in cm^3, and ρ is density in g/cm^3. Mmol Ca for the entirety of the portion of the rhizosphere sampled was then calculated by multiplying the total g of rhizosphere soil by the mmol Ca in one g of soil and compared to moles of Ca in each entire creosote bush (Table 30). Although the study by Nie (2009) took place at Eldorado Valley, the assumption was made that the soils from the Lucy Gray site would have a similar density due to the soils' similar climate, vegetation, and parent material.

Results from calculations of Ca content in each creosote bush show that there exists much less Ca in the entire shrub than in the rhizosphere soil. The roots from each creosote bush sampled in this study may have extended further than 1.5 m, and each shrub had at least two primary taproots diverging from the crown, which would further increase the rhizosphere Ca.

4.3 XRD and Optical Analyses

Soils from both sites had similar mineralogies as analyzed by XRD. At the Eldorado Valley field site, soil consisted of quartz, albite, muscovite, diopside, orthoclase, and trace calcite. At the Lucy Gray field site, soils consisted of quartz, albite, microcline, biotite, and amphibole as well as trace calcite. The minerals in the soils from both field sites are similar to the minerals found in granitic rocks and pedogenic carbonate. Calcite in granitic rocks may occur as fillings, disseminated grains, or replacement cores of plagioclase in the granitic parent material (White et al., 1999).

In addition to the XRD analyses, soil samples were also viewed optically for visible pedogenic $CaCO_3$ coatings on soil grains. Rhizosphere samples displayed very light or no $CaCO_3$ coatings on soil grains compared to interspace soils, which showed a visible dusting of $CaCO_3$. $CaCO_3$ also appeared to visibly increase with depth; deeper soils showed greater amounts of $CaCO_3$ than shallower soils. These optical observations are similar to conclusions drawn from sequential extractions, which showed increasing $CaCO_3$ in the interspaces relative to the rhizosphere and with depth.

5.0 Discussion

5.1 Interpretation

In this study we examined the impacts of creosote bush roots and biological soil crust on Ca distribution in desert soils to test their potential as a biosignature. Results of this study show that significant differences in both Ca from the exchangeable fraction and $CaCO_3$ are observed between samples impacted by creosote roots and soil samples in the interspace. These differences in soil Ca could be due to a number of ways that vegetation affect soil Ca concentrations, including a pH change in the rhizosphere from the efflux of organic acids or CO_2, the transport of water and solutes from the interspace by the creosote roots, and the uptake and circulation of Ca by biota.

Each of the abovementioned processes would have a different effect on the total Ca accessible by aqueous and biogeochemical processes (exchangeable Ca and $CaCO_3$ added together). If the dominant effect were the uptake of nutrients, we would expect to find less total available Ca in the rhizosphere compared to the interspace. If the dominant effect were the transport of water and solutes by the creosote roots from the interspace, or circulation of Ca by the creosote bush, we would expect to find more total available Ca in the rhizosphere. If the dominant effect were the dissolution of $CaCO_3$ in the rhizosphere, we would expect to find a similar amount of total available Ca in the rhizosphere and the interspace, as the Ca would be simply dissolving from the $CaCO_3$ and added to the exchangeable Ca fraction. Therefore, in order to test these three effects, we examined the total available Ca using a two-tailed paired t-test (see methods). No significant difference is seen between the amount of total available Ca in the rhizosphere and the interspace. Therefore, these data are consistent with the dissolution of $CaCO_3$ and addition of Ca to the exchangeable fraction, although other processes are likely impacting Ca concentrations.

We also find less estimated Ca in each creosote bush than in the rhizosphere, which implies that although the creosote bush is uptaking the Ca for its nutritional benefits, Ca is not a limiting nutrient in these desert soils. Previous studies have indicated that the Ca content of the plant is determined by the genetic requirement of the species rather than availability (Loneragan and Snowball, 1969).

Paired t-tests also showed that the rhizosphere soils had significantly lower pH than interspace soils. Plant roots are likely releasing CO_2 during natural metabolic processes, which then reacts with the soil water to form H_2CO_3, thereby lowering the pH of the soils nearest the plant roots. As well as CO_2, the creosote roots may be releasing organic acids into the rhizosphere, which would contribute to the pH decrease near the roots (Hoffland et al., 1989; Haynes, 1990; Drever and Stillings, 1997; Hinsinger et al., 2003; Garcia et al., 2005). This trend of lower pH observed near the roots likely contributes to an increase in the dissolution of $CaCO_3$ in the rhizosphere, resulting in the lower amount of $CaCO_3$ found in the rhizosphere in comparison to the interspace soils. The dissolution of $CaCO_3$ releases the Ca as Ca^{2+} ions in solution, therefore increasing the Ca in the exchangeable fraction.

In order to fully understand if Ca could be useful as a biosignature, it is important to understand the other processes that also affect the distribution of Ca. Factors such as soil texture, distribution of organic matter, infiltration, and runoff may play an important role in the distribution of Ca in desert soils. Some Mojave Desert studies have shown that infiltration is increased under shrubs, possibly due to the funneling of water via stemflow (Navar and Bryan, 1990) and increased organic matter and differences in soil texture (Titus et al., 2002). Further investigation of such processes would be important for future research.

Results for Ca concentrations in the exchangeable fraction in soil directly below the biological soil crust are similar to those found by Bernaldi-Campesi et al. (2009), in which crusted soil is found to contain less Ca compared to non-crusted soil. This has been interpreted as leaching of the Ca by the BSC to deeper soil (Bernaldi- Campesi et al., 2009). Microbial life, including BSCs, has been known to leach non-biogenic elements (Bernaldi-Campesi et al., 2009), which is consistent with our results. Other studies also show that BSCs can increase the availability of nutrients in the soil, in which higher levels of nutrients were found in plants that grew on soils with BSCs present (Belnap and Gardener, 1993). However, it has also been shown that crusted soils contain higher levels of some nutrients, such as Mn and Mg, than non-crusted soils (Bowker et al., 2006). It is important to obtain a better understanding of biological soil crust effects on soil processes. $CaCO_3$ values were not significantly different between the soil beneath the BSCs and non-crusted soil.

These results suggest the importance of biological impacts by creosote bush and biological soil crusts on Ca concentrations, with potential as a biosignature. In particular, results indicate significant differences between the rhizosphere and the interspaces, as well as crusted and non-crusted soils. In addition, the trend of decreasing exchangeable Ca and $CaCO_3$ with increasing creosote bush size suggests detectable impacts on Ca concentrations by the creosote bush. However, more work is needed to further understand whether biological impacts can be determined in the rock record.

5.2 Broader Implications

If Ca biosignatures are preserved in desert paleosols, then they could be used to determine the impacts of past vegetative life. Specifically, a signature of a greater amount of Ca in salts and a decreased amount of $CaCO_3$ compared to the surrounding soil could indicate the former location of the root-soil interface. Depletion of exchangeable Ca compared to surrounding soil could also indicate the past presence of BSC or other microbial life. Ca is an ideal signature to use in desert soils because it can remain in paleosols and in calcic horizons. At Mormon Mesa in southern Nevada, for example, petrocalcic horizons and other carbonate features formed from episodes of eolian deposition and pedogenic carbonate development persist for millions of years (Gardner, 1972; Brock and Buck, 2009). Ca biosignatures may therefore serve as a useful tool in determining the past presence of vegetation and other biological activity.

5.3 Future Work

Future work involving the analysis of Ca isotopes would further the use of Ca as a biosignature to deduce the past presence of plant or microbial life. Studies by Perakis et al. (2006), Page et al. (2008), Cenki-Tok et al. (2009), and Holmden and Bélanger (2010) show that vegetation influences Ca fractionation by preferential uptake of the lighter Ca isotopes, leaving the heavier isotopes in the soil. These studies were all performed in temperate environments; to understand the fractionation by creosote bush and biological soil crust in an arid setting may help contribute to an understanding of potential Ca isotopic biosignatures in desert soils and paleosols.

6.0 Conclusions

Significant differences are observed between soils from the rhizosphere compared to the plant interspaces, in which more Ca from the exchangeable fraction and less $CaCO_3$ is observed in the rhizosphere compared the interspace. Additionally, we observe a decreased pH closer to the plant roots, which likely result from the efflux of organic acids as well as CO_2 from the roots of the plant. The decreased pH may cause the dissolution of $CaCO_3$ in the rhizosphere, moving the Ca into the exchangeable fraction, as the total of the exchangeable fraction and $CaCO_3$ is not significantly different between the rhizosphere and the interspaces. Therefore, these differences in Ca could be used as a possible biosignature for ancient desert soils.

In addition to a possible vascular plant biosignature, soil Ca may also be able to be used to infer the past presence of biological soil crusts in desert landscapes. BSCs show a significant depletion of exchangeable Ca in soils directly underneath the soil crust when compared to adjacent surface soil located several centimeters away. This signature may be apparent at the paleosurface of the paleosol, as biological soil crusts occupy the top several centimeters of soil.

Results from this study suggest that Ca may be useful as a biosignature for identifying the past presence of both higher plants and microbial life such as biological soil crust. This would especially be useful in desert environments, where Ca persists in soils in $CaCO_3$, such as at Mormon Mesa where Ca has been preserved as pedogenic carbonate for possibly millions of years (Gardner, 1972). Additional research is needed to determine if Ca isotope fractionation in desert soils may also reflect biological interactions.

Appendix A: Figures

Figure 1

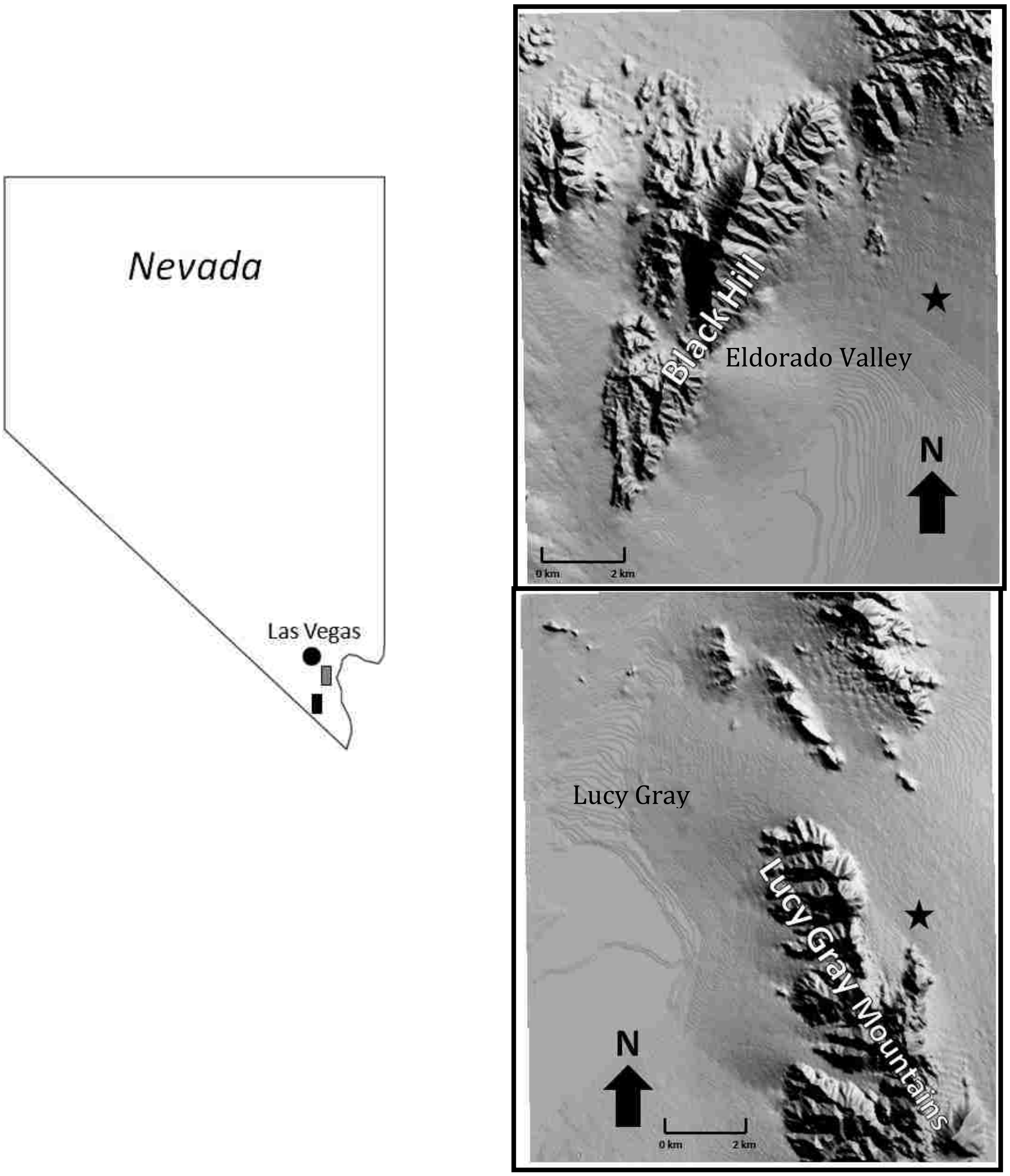

Figure 1. Maps of sample collection locations. The map of Nevada shows locations of the Eldorado Valley field site (gray rectangle) and the Lucy Gray field site (black rectangle) in relation to the city of Las Vegas. Shaded relief maps show the approximate location of each sampling location, indicated with a star.

Figure 2

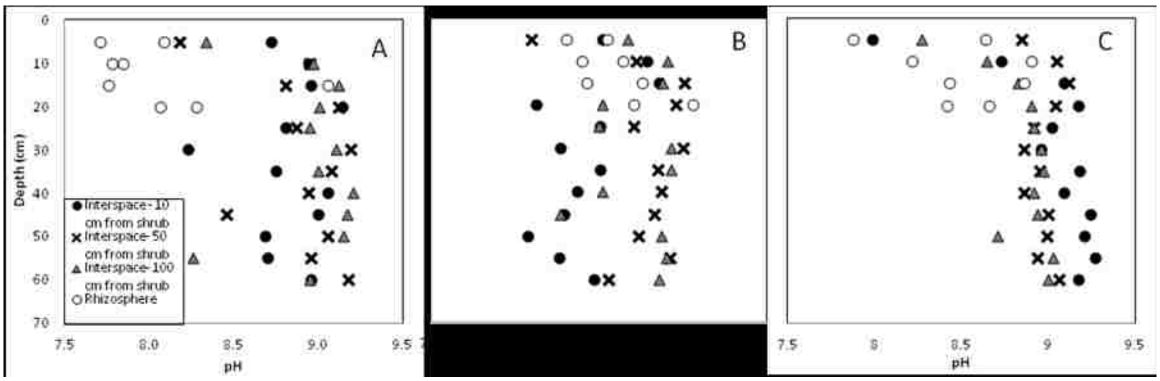

Figure 2. Soil pH from Eldorado Valley creosote bushes. Plots A, B, and C represent creosote bushes 1, 2, and 3 respectively. A lower, more neutral pH can be seen in soil samples from the rhizosphere (0-5 cm from the taproot), while samples from the interspace have a significantly higher pH (statistical tests performed at a significance level of 5%). PH in soils from all three creosote bushes increases with depth. Note: points are plotted at maximum sampling depth; therefore, samples plotted at a depth of 5 cm include soils sampled from a depth of 0-5 cm.

Figure 3

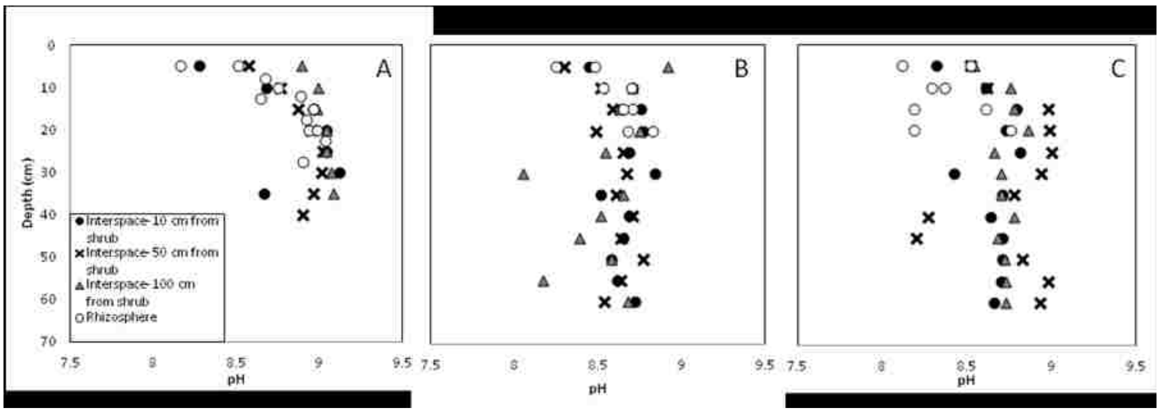

Figure 3. Soil pH from Lucy Gray creosote bushes. Plots A, B, and C represent creosote bushes 1, 2, and 3 respectively. A lower, more neutral pH can be seen in soil samples from the rhizosphere (0-5 cm from the taproot), while samples from the interspace have a higher pH (statistical tests performed at a significance level of 5%). Soil samples from all three creosote bushes have an increasing pH with depth. Note: points are plotted at maximum sampling depth; therefore, samples plotted at a depth of 5 cm include soils sampled from a depth of 0-5 cm.

Figure 4

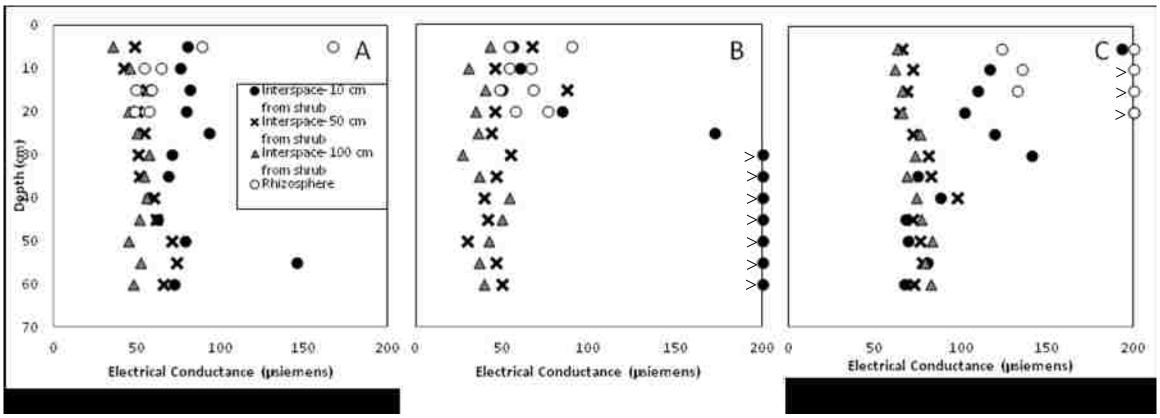

Figure 4. Electrical conductance of soil from Eldorado Valley creosote bushes. Plots A, B, and C represent creosote bushes 1, 2, and 3 respectively. Higher EC measurements are found in the rhizosphere soils and in interspace soils 10 cm from the plant, while interspace samples further from the plant have lower EC measurements (statistical tests performed at a significance level of 5%). Soils from Eldorado Valley creosote bushes C-2 (B) and C-3 (C) have a decrease in electrical conductance with increasing depth, while soils from Eldorado Valley creosote bush C-1 (A) have an increase in electrical conductance with depth. Points plotted at 200 µsiemens indicate an electrical conductance of greater than 200 µsiemens. Note: points are plotted at maximum sampling depth; therefore, samples plotted at a depth of 5 cm include soils sampled from a depth of 0-5 cm.

Figure 5

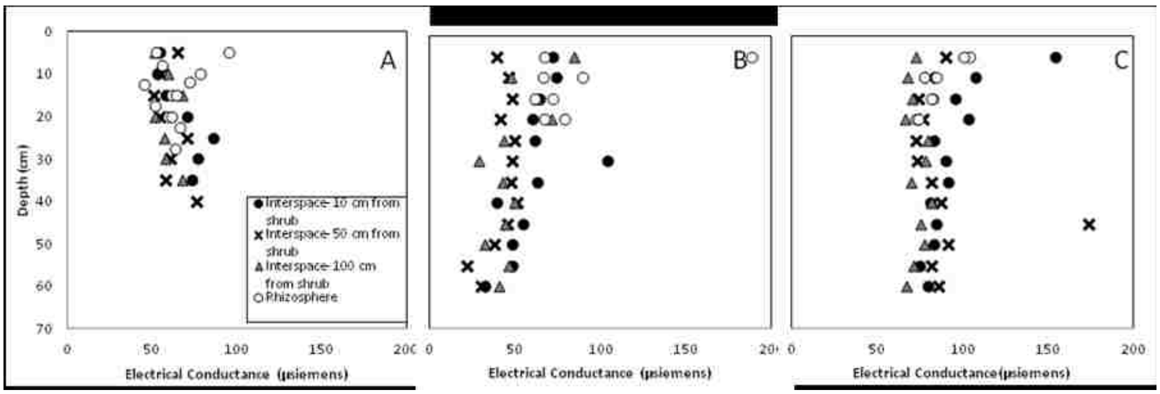

Figure 5. Electrical conductance of soil from Lucy Gray creosote bushes. Plots A, B, and C represent creosote bushes 1, 2, and 3 respectively. Higher EC measurements are found in the rhizosphere soils and in interspace soils 10 cm from the plant, while interspace samples further from the plant have lower EC measurements (statistical tests performed at a significance level of 5%). Soils from Lucy Gray creosote bushes C-2 (B) and C-3 (C) decrease in electrical conductance with depth, while soils from Lucy Gray creosote bush C-1 (A) increases in electrical conductance with depth. Points plotted at 200 µsiemens indicate an electrical conductance of greater than 200 µsiemens. Note: points are plotted at maximum sampling depth; therefore, samples plotted at a depth of 5 cm include soils sampled from a

Figure 6

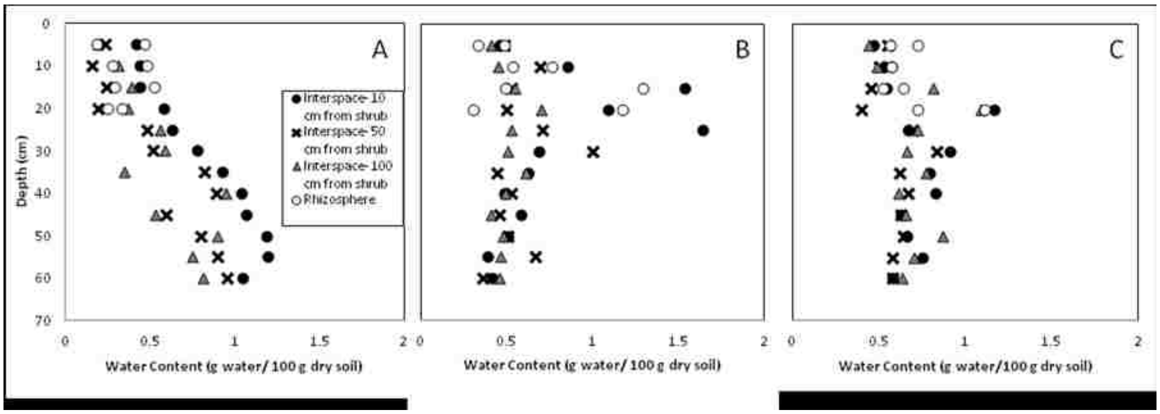

Figure 6. Water content (g water/ 100 g dry soil) of Eldorado Valley creosote bushes. Plots A, B, and C represent creosote bushes 1, 2, and 3 respectively. Water content of soils from Eldorado Valley creosote bushes C-1 (A) and C-3 (C) increase with depth. Water content of soils from Eldorado Valley creosote bush C-2 (B) do not increase with depth. Note: points are plotted at maximum sampling depth; therefore, samples plotted at a depth of 5 cm include soils sampled from a depth of 0-5 cm.

Figure 7

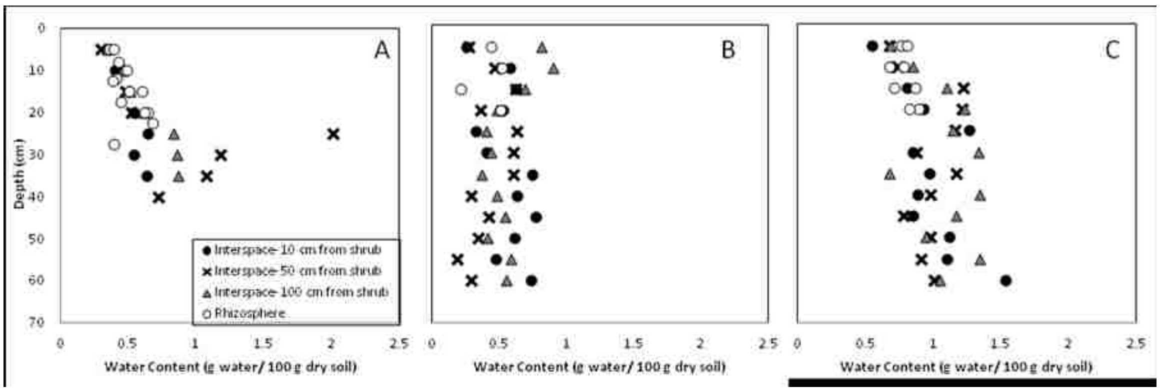

Figure 7. Soil water content (g water/ 100 g dry soil) from Lucy Gray creosote bushes. Plots A, B, and C represent creosote bushes 1, 2, and 3 respectively. Water content of soils from Lucy Gray creosote bushes C-1 (A) and C-3 (C) increase with depth, while soils from Lucy Gray creosote bush C-2 (B) do not. Note: points are plotted at maximum sampling depth; therefore, samples plotted at a depth of 5 cm include soils sampled from a depth of 0-5 cm.

Figure 8

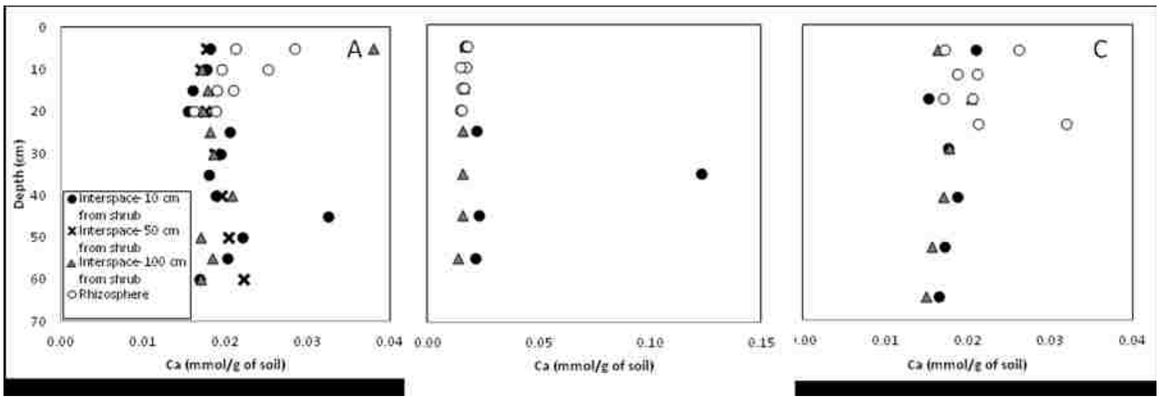

Figure 8. Ca from the exchangeable fraction for Eldorado Valley Creosote bushes. Plots A, B, and C represent creosote bushes 1, 2, and 3 respectively. Although natural variability was observed, Ca concentrations in the exchangeable fraction are significantly higher in the rhizosphere than in samples from the interspace (statistical tests performed at a significance level of 5%). For soils from all three creosote bushes, exchangeable Ca decreases with increasing depth. Standard deviation of repeated measurements of low-concentration Ca standards on the Atomic Absorption Spectrometer was 1%; error bars of 2 standard deviations (2%) are smaller than plotted points. The natural variation of the data is much larger than the uncertainty. Note: points are plotted at maximum sampling depth; therefore, samples plotted at a depth of 5 cm include soils sampled from a depth of 0-5 cm.

Figure 9

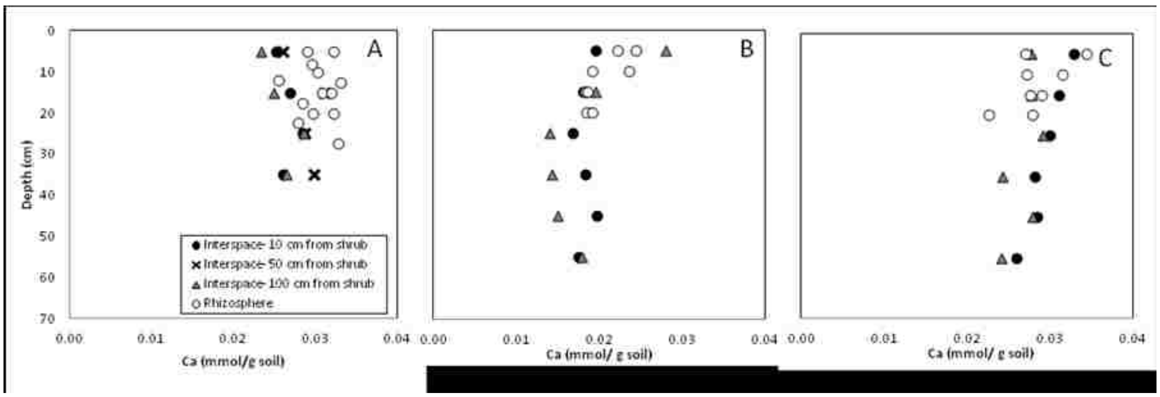

Figure 9. Ca from the exchangeable fraction from Lucy Gray creosote bushes. Plots A, B, and C represent creosote bushes 1, 2, and 3 respectively. Ca concentrations in the exchangeable fraction are higher in the rhizosphere than in samples from the interspace (statistical tests performed at a significance level of 5%). Soils from Lucy Gray creosote bushes C-2 (B) and C-3 (C) decrease in exchangeable Ca with depth, while soils from Lucy Gray creosote bush C-1 (A) increase slightly in exchangeable Ca with depth. Standard deviation of repeated measurements of low-concentration Ca standards on the Atomic Absorption Spectrometer was 1%; error bars of 2 standard deviations (2%) are smaller than plotted points. The natural variation of the data is much larger than the uncertainty. Note: points are plotted at maximum sampling depth; therefore, samples plotted at a depth of 5 cm include soils sampled from a depth of 0-5 cm.

Figure 10

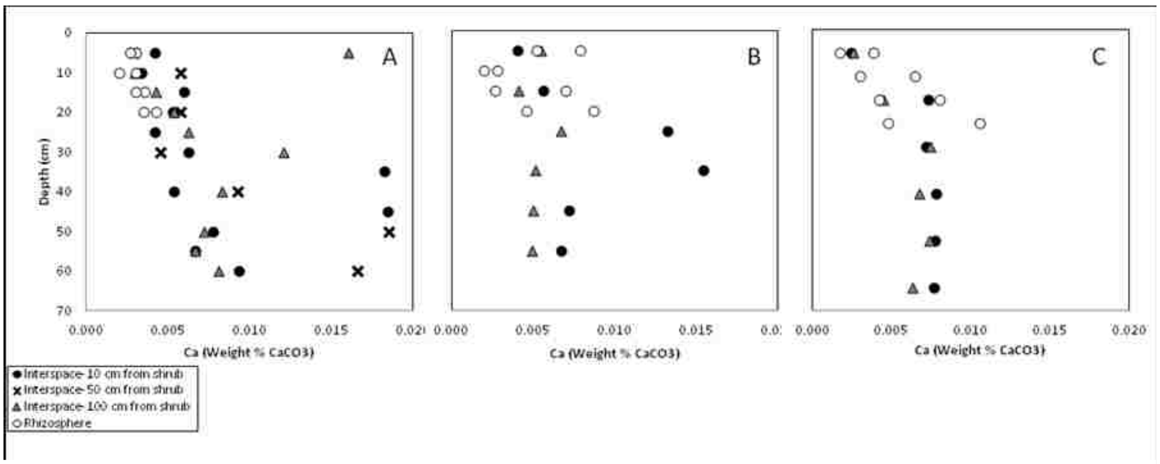

Figure 10. Ca from $CaCO_3$ for soils from Eldorado Valley creosote bushes. Plots A, B, and C represent creosote bushes 1, 2, and 3 respectively. $CaCO_3$ is decreased in the rhizosphere, while higher amounts of $CaCO_3$ are observed in the interspaces at 10 cm and 100 cm from the shrub (statistical tests performed at a significance level of 5%). For soils from all three plants, the amount of $CaCO_3$ increases with depth. Standard deviation of repeated measurements of low-concentration Ca standards on the Atomic Absorption Spectrometer was 1%; error bars of 2 standard deviations (2%) are smaller than plotted points. The natural variation of the data is much larger than the uncertainty. Note: points are plotted at maximum sampling depth; therefore, samples plotted at a depth of 5 cm include soils sampled from a depth of 0-5 cm.

Figure 11

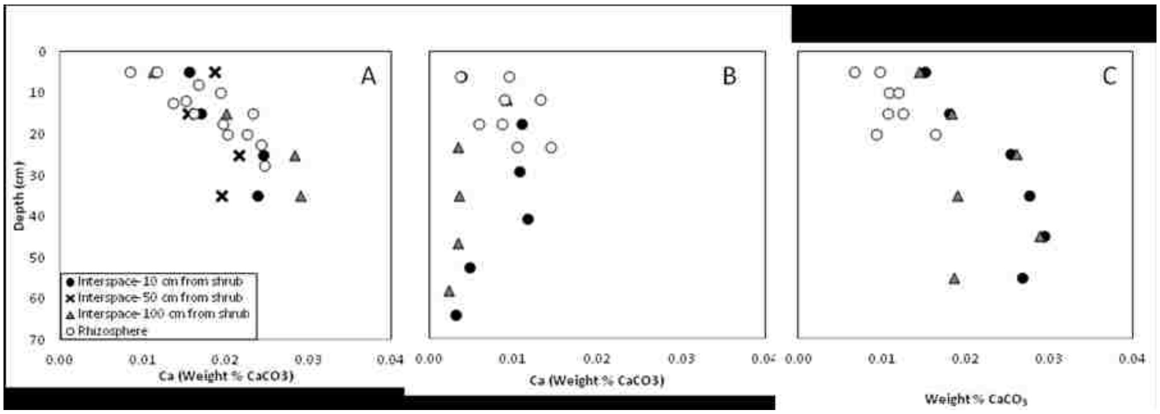

Figure 11. Ca from $CaCO_3$ for soils from Eldorado Valley creosote bushes. Plots A, B, and C represent creosote bushes 1, 2, and 3 respectively. $CaCO_3$ is decreased in the rhizosphere, while higher amounts of $CaCO_3$ are observed in the interspaces (statistical tests performed at a significance level of 5%). Soils from Lucy Gray creosote bushes C-1 (A) and C-3 (C) increase in $CaCO_3$ with depth, while soils from Lucy Gray creosote bush C-2 (B) decrease in $CaCO_3$ with depth. Standard deviation of repeated measurements of low-concentration Ca standards on the Atomic Absorption Spectrometer was 1%; error bars of 2 standard deviations (2%) are smaller than plotted points. The natural variation of the data is much larger than the uncertainty. Note: points are plotted at maximum sampling depth; therefore, samples plotted at a depth of 5 cm include soils sampled from a depth of 0-5 cm.

Appendix B: Tables

Table 1

Table 1. pH values of two roots from each creosote bush compared. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3); r indicates radial distance from root; d indicates depth. Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data do not provide evidence to support that the rhizosphere soils vary significantly from each other at the 5% significance level, and were therefore averaged for further analyses.

Soil Sample ID	**Sampling Depth (cm)**	**pH (1st Root)**	**pH (2nd root)**	**Paired Difference (2nd root -1st root)**
Eldorado Valley				
EV C-1, 0-5r, 0-5d	0-5	8.09	7.71	-0.38
EV C-1, 0-5r, 5-10d	5-10	7.78	7.85	0.07
EV C-1, 0-5r, 10-15d	20-15	9.06	7.76	-1.3
EV C-1, 0-5r, 15-20d	15-20	8.28	8.07	-0.21
EV C-2, 0-5r, 0-5d	0-5	8.55	8.31	-0.24
EV C-2, 0-5r, 5-10d	5-10	8.4	8.64	0.24
EV C-2, 0-5r, 10-15d	10-15	8.43	8.76	0.33
EV C-2, 0-5r, 15-20d	15-20	8.71	9.06	0.35
EV C-3, 0-5r, 0-5d	0-5	7.88	8.64	0.76
EV C-3, 0-5r, 5-10d	5-10	8.22	8.9	0.68
EV C-3, 0-5r, 10-15d	10-15	8.43	8.86	0.43
EV C-3, 0-5r, 15-20d	15-20	8.42	8.66	0.24
Lucy Gray				
LG C-1, 0-5r, 0-5d	0-5	8.16	8.51	0.35
LG C-1, 0-5r, 5-10d	5-10	8.67	8.75	0.08
LG C-1, 0-5r, 10-15d	10-15	8.96	8.96	0
LG C-1, 0-5r, 15-20d	15-20	8.93	8.98	0.05
LG C-2, 0-5r, 0-5d	0-5	8.48	8.25	-0.23
LG C-2, 0-5r, 5-10d	5-10	8.7	8.53	-0.17
LG C-2, 0-5r, 10-15d	10-15	8.71	8.65	-0.06
LG C-2, 0-5r, 15-20d	15-20	8.68	8.83	0.15
LG C-3, 0-5r, 0-5d	0-5	8.12	8.52	0.4
LG C-3, 0-5r, 5-10d	5-10	8.29	8.37	0.08
LG C-3, 0-5r, 10-15d	10-15	8.19	8.61	0.42
LG C-3, 0-5r, 15-20d	15-20	8.19	8.76	0.57

Table 2

Table 2. Electrical conductance values of two roots from each creosote bush compared. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3); r indicates radial distance from root; d indicates depth. Results are reported in µsiemens. Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data do not provide evidence to support that the rhizosphere soils vary significantly from each other at the 5% significance level, and were therefore

Soil Sample ID	**Sampling Depth (cm)**	**EC (1st Root) (µsiemens)**	**EC (2nd root) (µsiemens)**	**Paired Difference (2nd root -1st root) (µsiemens)**
Eldorado Valley				
EV C-1, 0-5r, 0-5d	0-5	89	166.7	77.7
EV C-1, 0-5r, 5-10d	5-10	54.4	64.5	10.1
EV C-1, 0-5r, 10-15d	20-15	58.7	49.4	-9.3
EV C-1, 0-5r, 15-20d	15-20	57.4	48.3	-9.1
EV C-2, 0-5r, 0-5d	0-5	54.1	90	35.9
EV C-2, 0-5r, 5-10d	5-10	54.1	66.3	12.2
EV C-2, 0-5r, 10-15d	10-15	48.5	68	19.5
EV C-2, 0-5r, 15-20d	15-20	57.8	76.5	18.7
EV C-3, 0-5r, 0-5d	0-5	200	123.5	-76.5
EV C-3, 0-5r, 5-10d	5-10	200	135.4	-64.6
EV C-3, 0-5r, 10-15d	10-15	200	132.5	-67.5
EV C-3, 0-5r, 15-20d	15-20	200	200	0
LG C-1, 0-5r, 0-5d		52.6	95.3	42.7
Lucy Gray	0-5			
LG C-1, 0-5r, 5-10d	5-10	55.8	78.8	23
LG C-1, 0-5r, 10-15d	10-15	61.3	64.5	3.2
LG C-1, 0-5r, 15-20d	15-20	59.8	61.9	2.1
LG C-2, 0-5r, 0-5d	0-5	188.5	67.5	-121
LG C-2, 0-5r, 5-10d	5-10	66.4	89.6	23.2
LG C-2, 0-5r, 10-15d	10-15	72.3	61.5	-10.8
LG C-2, 0-5r, 15-20d	15-20	67.2	79.2	12
LG C-3, 0-5r, 0-5d	0-5	104.3	101	-3.3
LG C-3, 0-5r, 5-10d	5-10	78	84.6	6.6
LG C-3, 0-5r, 10-15d	10-15	82.5	81.8	-0.7
LG C-3, 0-5r, 15-20d	15-20	73.1	74.4	1.3

Table 3

Table 3. Water content of two roots from each creosote bush compared. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3); r indicates radial distance from root; d indicates depth. Results are reported in g water/ 100 g dry soil. Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data do not provide evidence to support that the rhizosphere soils vary significantly from each other at the 5% significance level, and were therefore averaged for further analyses.

Soil Sample ID	**Sampling Depth (cm)**	**Water Content (1st Root) (g water/ 100 g dry soil)**	**Water Content (2nd root) (g water/ 100 g dry soil)**	**Paired Difference (2nd root -1st root) (g water/ 100 g dry soil)**
Eldorado Valley				
EV C-1, 0-5r, 0-5d	0-5	0.46	0.19	-0.28
EV C-1, 0-5r, 5-10d	5-10	0.48	0.28	-0.20
EV C-1, 0-5r, 10-15d	20-15	0.52	0.29	-0.24
EV C-1, 0-5r, 15-20d	15-20	0.25	0.33	0.08
EV C-2, 0-5r, 0-5d	0-5	0.33	0.49	0.16
EV C-2, 0-5r, 5-10d	5-10	0.53	0.76	0.23
EV C-2, 0-5r, 10-15d	10-15	0.49	1.29	0.80
EV C-2, 0-5r, 15-20d	15-20	0.30	1.17	0.87
EV C-3, 0-5r, 0-5d	0-5	0.72	0.56	-0.16
EV C-3, 0-5r, 5-10d	5-10	0.57	0.57	0.00
EV C-3, 0-5r, 10-15d	10-15	0.64	0.52	-0.11
EV C-3, 0-5r, 15-20d	15-20	0.72	1.10	0.39
Lucy Gray				
LG C-1, 0-5r, 0-5d	0-5	0.36	0.39	0.03
LG C-1, 0-5r, 5-10d	5-10	0.43	0.49	0.06
LG C-1, 0-5r, 10-15d	10-15	0.51	0.60	0.10
LG C-1, 0-5r, 15-20d	15-20	0.65	0.62	-0.02
LG C-2, 0-5r, 0-5d	0-5	0.54	0.44	-0.10
LG C-2, 0-5r, 5-10d	5-10	0.33	0.52	0.19
LG C-2, 0-5r, 10-15d	10-15	0.55	0.21	-0.34
LG C-2, 0-5r, 15-20d	15-20	0.48	0.51	0.03
LG C-3, 0-5r, 0-5d	0-5	0.77	0.81	0.04
LG C-3, 0-5r, 5-10d	5-10	0.68	0.79	0.10
LG C-3, 0-5r, 10-15d	10-15	0.71	0.87	0.16
LG C-3, 0-5r, 15-20d	15-20	0.90	0.83	-0.07

Table 4

Table 4. Calcium from the exchangeable fraction of two roots from each creosote bush compared. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3); r indicates radial distance from root; d indicates depth. Results are reported in mmol Ca/g soil. Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data do not provide evidence to support that the rhizosphere soils vary significantly from each other at the 5% significance level, and were therefore averaged for further analyses.

Soil Sample ID	**Sampling Depth**	**1st root (mmol Ca/g soil)**	**2nd root (mmol Ca/g soil)**	**Paired Difference (mmol Ca/g soil)**
Eldorado Valley				
EV C-1, 0-5r, 0-5d	0-5	0.021	0.028	0.007
EV C-1, 0-5r, 5-10d	5-10	0.019	0.025	0.006
EV C-1, 0-5r, 10-15d	10-15	0.019	0.021	0.002
EV C-1, 0-5r, 15-20d	15-20	0.016	0.019	0.003
EV C-2, 0-5r, 0-5d	0-5	0.017	0.018	0.001
EV C-2, 0-5r, 10-15d	10-15	0.015	0.016	0.001
EV C-3,0-5r, 0-5d	0-5	0.026	0.017	-0.009
EV C-3,0-5r, 10-15d	10-15	0.021	0.017	-0.004
Lucy Gray				
LG C-1 0-5r, 0-5d	0-5	0.029	0.032	0.003
LG C-1 0-5r, 10-15d	10-15	0.031	0.032	0.001
LG C-2, 0-5r, 0-5d	0-5	0.022	0.024	0.002
LG C-2, 0-5r, 10-15d	10-15	0.018	0.019	0.000
LG C-3, 0-5r, 0-5d	0-5	0.034	0.027	-0.007
LG C-3, 0-5r, 10-15d	10-15	0.029	0.028	-0.001

Table 5

Table 5. Calcium from $CaCO_3$ of two roots from each creosote bush compared. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3); r indicates radial distance from root; d indicates depth. Results are reported in weight % $CaCO_3$. Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data do not provide evidence to support that the rhizosphere soils vary significantly from each other at the 5% significance level, and were therefore averaged for further analyses.

Soil Sample ID	**Sampling Depth**	**1st root (weight % CaCO3)**	**2nd root (weight % CaCO3)**	**Paired Difference (weight % CaCO3)**
Eldorado Valley				
EV C-1, 0-5r, 0-5d	0-5	0.0030	0.0027	-0.0004
EV C-1, 0-5r, 5-10d	5-10	0.0020	0.0030	0.0010
EV C-1, 0-5r, 10-15d	10-15	0.0036	0.0030	-0.0006
EV C-1, 0-5r, 15-20d	15-20	0.0043	0.0035	-0.0007
EV C-2, 0-5r, 0-5d	0-5	0.0079	0.0052	-0.0027
EV C-2, 0-5r, 10-15d	10-15	0.0027	0.0070	0.0043
EV C-3, 0-5r, 0-5d	0-5	0.0017	0.0038	0.0021
EV C-3, 0-5r, 10-15d	10-15	0.0042	0.0080	0.0038
Lucy Gray				
LG C-1, 0-5r, 0-5d	0-5	0.0116	0.0084	-0.0031
LG C-1, 0-5r, 12-15d	10-15	0.0160	0.0233	0.0072
LG C-2, 0-5r, 0-5d	0-5	0.0095	0.0037	-0.0058
LG C-2, 0-5r, 10-15d	10-15	0.0086	0.0059	-0.0027
LG C-3, 0-5r, 0-5d	0-5	0.0066	0.0097	0.0031
LG C-3, 0-5r, 10-15d	10-15	0.0125	0.0107	-0.0018

Table 6

Table 6. Calcium from the exchangeable fraction (top table) and $CaCO_3$ (bottom table) for all soil samples from the near-root samples and averaged 10 cm and 100 cm interspaces at depths up to 20 cm. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3). Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data do not provide evidence to support that the near root soils contain a significantly different amount of exchangeable Ca or $CaCO_3$ than the interspace soils at the 5% significance level. Because near-root samples were not significantly different from interspace samples and were only analyzed from the first creosote bushes at each field site, the results are not considered further.

Soil Sample ID	**Sampling Depth (cm)**	**Near Root (mmol Ca/g soil)**	**Interspace (average) (mmol Ca/g soil)**	**Paired Difference (near root-interspace) (mmol Ca/g soil)**
Eldorado Valley				
EV C-1, 0-5	0-5	0.019	0.028	-0.009
EV C-1, 5-10	5-10	0.018	0.017	0.001
Lucy Gray				
LG C-1, 0-5	0-5	0.033	0.024	0.008
LG C-1, 10-15	5-10	0.028	0.026	0.002
Soil Sample ID	**Sampling Depth (cm)**	**Near Root (weight % $CaCO_3$)**	**Interspace (average) (weight % $CaCO_3$)**	**Paired Difference (near root-interspace) (weight % $CaCO_3$)**
Eldorado Valley				
EV C-1, 0-5	0-5	0.0042	0.0101	-0.0059
EV C-1, 5-10	5-10	0.0046	0.0032	0.0014
Lucy Gray				
LG C-1, 0-5	0-5	0.0184	0.0133	0.0051
LG C-1, 10-15	5-10	0.0278	0.0185	0.0093

Table 7

Table 7. pH of average rhizosphere soils compared to interspace soils collected 10 cm from the creosote bush. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3); r indicates radial distance from root; d indicates depth. Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data provide evidence that soils from the 10 cm interspace have significantly higher pH values than the rhizosphere at the 5% significance level.

Soil Sample ID	**Sampling Depth (cm)**	**Rhizosphere pH (average)**	**10 cm Interspace pH**	**Paired Difference (interspace- rhizosphere)**
Eldorado Valley				
EV C-1 0-5	0-5	7.90	8.72	0.82
EV C-1 5-10	5-10	7.81	8.94	1.13
EV C-1 10-15	20-15	8.41	8.96	0.55
EV C-1 15-20	15-20	8.18	9.14	0.97
EV C-2 0-5	0-5	8.26	8.52	0.26
EV C-2 5-10	5-10	8.56	8.79	0.23
EV C-2 10-15	10-15	8.65	8.86	0.22
EV C-2 15-20	15-20	8.54	8.13	-0.41
EV C-3 0-5	0-5	8.37	7.99	-0.38
EV C-3 5-10	5-10	8.62	8.73	0.12
EV C-3 10-15	10-15	8.68	9.09	0.41
EV C-3 15-20	15-20	8.76	9.17	0.42
Lucy Gray				
LG C-1 0-5	0-5	8.43	8.27	-0.16
LG C-1 5-10	5-10	8.52	8.68	0.16
LG C-1 10-15	10-15	8.60	8.96	0.37
LG C-1 15-20	15-20	8.89	9.04	0.15
LG C-2 0-5	0-5	8.34	8.45	0.11
LG C-2 5-10	5-10	8.71	8.71	0.00
LG C-2 10-15	10-15	8.96	8.76	-0.20
LG C-2 15-20	15-20	8.96	8.77	-0.19
LG C-3 0-5	0-5	8.32	8.32	0.00
LG C-3 5-10	5-10	8.33	8.61	0.28
LG C-3 10-15	10-15	8.40	8.79	0.39
LG C-3 15-20	15-20	8.48	8.73	0.26

Table 8

Table 8. pH of average rhizosphere soils compared to interspace soils collected 100 cm from the creosote bush. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3); r indicates radial distance from root; d indicates depth. Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data provide evidence that soils from the 100 cm interspace have significantly higher pH values than the rhizosphere at the 5% significance level.

Soil Sample ID	**Sampling Depth (cm)**	**Rhizosphere pH (average)**	**100 cm Interspace pH**	**Paired Difference (interspace- rhizosphere)**
Eldorado Valley				
EV C-1 0-5	0-5	7.9	8.34	0.44
EV C-1 5-10	5-10	7.82	8.97	1.16
EV C-1 10-15	20-15	8.41	9.12	0.71
EV C-1 15-20	15-20	8.18	9.01	0.83
EV C-2 0-5	0-5	8.26	8.67	0.41
EV C-2 5-10	5-10	8.56	8.91	0.35
EV C-2 10-15	10-15	8.65	8.88	0.24
EV C-2 15-20	15-20	8.54	8.52	-0.02
EV C-3 0-5	0-5	8.37	8.27	-0.10
EV C-3 5-10	5-10	8.62	8.65	0.04
EV C-3 10-15	10-15	8.68	8.83	0.15
EV C-3 15-20	15-20	8.76	8.9	0.15
Lucy Gray				
LG C-1 0-5	0-5	8.43	8.89	0.46
LG C-1 5-10	5-10	8.52	8.99	0.47
LG C-1 10-15	10-15	8.60	8.98	0.39
LG C-1 15-20	15-20	8.89	9.04	0.15
LG C-2 0-5	0-5	8.34	8.92	0.58
LG C-2 5-10	5-10	8.71	8.71	0.00
LG C-2 10-15	10-15	8.96	8.63	-0.33
LG C-2 15-20	15-20	8.96	8.75	-0.21
LG C-3 0-5	0-5	8.32	8.54	0.22
LG C-3 5-10	5-10	8.33	8.76	0.43
LG C-3 10-15	10-15	8.40	8.78	0.38
LG C-3 15-20	15-20	8.48	8.86	0.39

Table 9

Table 9. Electrical conductance of average rhizosphere soils compared to interspace soils collected 10 cm from the creosote bush. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3); r indicates radial distance from root; d indicates depth. Results are reported in µsiemens. Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data do not provide evidence that either the rhizosphere or the interspace have significantly higher electrical conductance at the 5% significance level.

Soil Sample ID	**Sampling Depth (cm)**	**Rhizosphere EC (average) (µsiemens)**	**Interspace EC (10 cm) (µsiemens)**	**Paired Difference (interspace- rhizosphere) (µsiemens)**
Eldorado Valley				
EV C-1 0-5	0-5	127.9	80.1	-47.8
EV C-1 5-10	5-10	59.5	75.6	16.2
EV C-1 10-15	20-15	54	81.6	27.6
EV C-1 15-20	15-20	52.9	79.6	26.8
EV C-2 0-5	0-5	161.8	56	-105.8
EV C-2 5-10	5-10	167.7	60.2	-107.5
EV C-2 10-15	10-15	166.3	49.9	-116.4
EV C-2 15-20	15-20	200	84.4	-115.6
EV C-3 0-5	0-5	128	193.2	65.2
EV C-3 5-10	5-10	78	117	39
EV C-3 10-15	10-15	66.9	109.7	42.8
EV C-3 15-20	15-20	73.2	102.2	29
Lucy Gray				
LG C-1 0-5	0-5	72.1	54.4	-17.7
LG C-1 5-10	5-10	60.2	53.4	-6.8
LG C-1 10-15	10-15	58.3	57.9	-0.4
LG C-1 15-20	15-20	67.2	70.8	3.7
LG C-2 0-5	0-5	74	72	-2
LG C-2 5-10	5-10	67.3	74.3	7
LG C-2 10-15	10-15	62.9	64.7	1.8
LG C-2 15-20	15-20	60.9	60	-0.9
LG C-3 0-5	0-5	102.7	154	51.4
LG C-3 5-10	5-10	81.3	107.6	26.3
LG C-3 10-15	10-15	82.2	95.6	13.5
LG C-3 15-20	15-20	73.8	103.5	29.8

Table 10

Table 10. Electrical conductance of average rhizosphere soils compared to interspace soils collected 100 cm from the creosote bush. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3); r indicates radial distance from root; d indicates depth. Results are reported in µsiemens. Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data provide evidence that soils from the 100 cm interspace have significantly higher electrical conductance values than the rhizosphere at the 5% significance level.

Soil Sample ID	**Sampling Depth (cm)**	**Rhizosphere EC (average) (µsiemens)**	**Interspace EC (100 cm) (µsiemens)**	**Paired Difference (interspace-rhizosphere) (µsiemens)**
Eldorado Valley				
EV C-1 0-5	0-5	127.9	35.5	-92.4
EV C-1 5-10	5-10	59.5	45.9	-13.6
EV C-1 10-15	20-15	54.1	56.1	2.1
EV C-1 15-20	15-20	52.9	45.2	-7.7
EV C-2 0-5	0-5	161.8	43	-118.8
EV C-2 5-10	5-10	167.7	30.4	-137.3
EV C-2 10-15	10-15	166.3	40.5	-125.8
EV C-2 15-20	15-20	200	34.9	-165.1
EV C-3 0-5	0-5	128	62.8	-65.2
EV C-3 5-10	5-10	78	62	-16
EV C-3 10-15	10-15	66.9	65.8	-1.1
EV C-3 15-20	15-20	73.2	66.1	-7.1
Lucy Gray				
LG C-1 0-5	0-5	72.1	52	-20.1
LG C-1 5-10	5-10	60.2	59.2	-1
LG C-1 10-15	10-15	58.3	68	9.75
LG C-1 15-20	15-20	67.2	52	-15.2
LG C-2 0-5	0-5	74	84.6	10.7
LG C-2 5-10	5-10	67.3	47.6	-19.7
LG C-2 10-15	10-15	62.9	62.8	-0.1
LG C-2 15-20	15-20	60.9	71.2	10.4
LG C-3 0-5	0-5	102.7	73	-29.7
LG C-3 5-10	5-10	81.3	68.1	-13.2
LG C-3 10-15	10-15	82.2	70.8	-11.4
LG C-3 15-20	15-20	73.8	66.8	-7

Table 11

Table 11. Water content of average rhizosphere soils compared to interspace soils collected 10 cm from the creosote bush. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3); r indicates radial distance from root; d indicates depth. Results are reported in g water/ 100 g dry soil. Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data do not provide evidence that either the rhizosphere or the interspace have significantly greater water content at the 5% significance level.

Soil Sample ID	**Sampling Depth (cm)**	**Rhizosphere water content (average) (g water/ 100 g dry soil)**	**Interspace water content (10 cm) (g water/ 100 g dry soil)**	**Paired Difference (rhizosphere-interspace) (g water/ 100 g dry soil)**
Eldorado Valley				
EV C-1 0-5	0-5	0.33	0.42	0.09
EV C-1 5-10	5-10	0.38	0.44	0.06
EV C-1 10-15	20-15	0.41	0.44	0.03
EV C-1 15-20	15-20	0.29	0.58	0.29
EV C-2 0-5	0-5	0.64	0.46	-0.18
EV C-2 5-10	5-10	0.57	0.85	0.29
EV C-2 10-15	10-15	0.58	1.53	0.95
EV C-2 15-20	15-20	0.91	1.09	0.18
EV C-3 0-5	0-5	0.49	0.46	-0.02
EV C-3 5-10	5-10	0.43	0.53	0.10
EV C-3 10-15	10-15	0.38	0.54	0.16
EV C-3 15-20	15-20	0.49	1.17	0.67
Lucy Gray				
LG C-1 0-5	0-5	0.41	0.35	-0.06
LG C-1 5-10	5-10	0.65	0.41	-0.24
LG C-1 10-15	10-15	0.89	0.51	-0.38
LG C-1 15-20	15-20	0.74	0.55	-0.19
LG C-2 0-5	0-5	0.38	0.26	-0.12
LG C-2 5-10	5-10	0.46	0.58	0.12
LG C-2 10-15	10-15	0.56	0.63	0.07
LG C-2 15-20	15-20	0.63	0.53	-0.10
LG C-3 0-5	0-5	0.79	0.55	-0.24
LG C-3 5-10	5-10	0.73	0.70	-0.04
LG C-3 10-15	10-15	0.79	0.81	0.02
LG C-3 15-20	15-20	0.86	0.93	0.06

Table 12

Table 12. Water content of average rhizosphere soils compared to interspace soils collected 100 cm from the creosote bush. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3); r indicates radial distance from root; d indicates depth. Results are reported in g water/ 100 g dry soil. Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data do not provide evidence that either the rhizosphere or the interspace have significantly greater water content at the 5% significance level.

Soil Sample ID	Sampling Depth (cm)	Rhizosphere water content (average) (g water/ 100 g dry soil)	Interspace water content (100 cm) (g water/ 100 g dry soil)	Paired Difference (rhizosphere-interspace) (g water/ 100 g dry soil)
Eldorado Valley				
EV C-1 0-5	0-5	0.33	0.19	-0.13
EV C-1 5-10	5-10	0.38	0.31	-0.07
EV C-1 10-15	20-15	0.41	0.39	-0.02
EV C-1 15-20	15-20	0.29	0.36	0.07
EV C-2 0-5	0-5	0.64	0.41	-0.23
EV C-2 5-10	5-10	0.57	0.45	-0.12
EV C-2 10-15	10-15	0.58	0.55	-0.03
EV C-2 15-20	15-20	0.91	0.70	-0.21
EV C-3 0-5	0-5	0.49	0.44	-0.05
EV C-3 5-10	5-10	0.43	0.48	0.06
EV C-3 10-15	10-15	0.38	0.81	0.43
EV C-3 15-20	15-20	0.49	1.09	0.59
Lucy Gray				
LG C-1 0-5	0-5	0.41	0.34	-0.06
LG C-1 5-10	5-10	0.65	0.45	-0.19
LG C-1 10-15	10-15	0.89	0.51	-0.38
LG C-1 15-20	15-20	0.74	0.61	-0.13
LG C-2 0-5	0-5	0.38	0.81	0.44
LG C-2 5-10	5-10	0.46	0.90	0.44
LG C-2 10-15	10-15	0.56	0.69	0.14
LG C-2 15-20	15-20	0.63	0.49	-0.15
LG C-3 0-5	0-5	0.79	0.69	-0.10
LG C-3 5-10	5-10	0.73	0.85	0.12
LG C-3 10-15	10-15	0.79	1.10	0.31
LG C-3 15-20	15-20	0.86	1.23	0.37

Table 13

Table 13. pH values of the two interspace distances (10 and 100 cm from the creosote bush) for each creosote bush compared. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3); r indicates radial distance from root; d indicates depth. Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data do not provide evidence to support that the interspace soils vary significantly from each other at the 5% significance level.

Soil Sample ID	**Sampling Depth (cm)**	**pH (10 cm)**	**pH (100 cm)**	**Paired Difference (100 cm-10 cm)**
Eldorado Valley				
EV C-1 0-5	0-5	8.72	8.34	-0.38
EV C-1 5-10	5-10	8.94	8.97	0.03
EV C-1 10-15	20-15	8.96	9.12	0.16
EV C-1 15-20	15-20	9.14	9.01	-0.13
EV C-2 0-5	0-5	8.52	8.67	0.15
EV C-2 5-10	5-10	8.79	8.91	0.12
EV C-2 10-15	10-15	8.86	8.88	0.02
EV C-2 15-20	15-20	8.13	8.52	0.39
EV C-3 0-5	0-5	7.99	8.27	0.28
EV C-3 5-10	5-10	8.73	8.65	-0.08
EV C-3 10-15	10-15	9.09	8.83	-0.26
EV C-3 15-20	15-20	9.17	8.9	-0.27
Lucy Gray				
LG C-1 0-5	0-5	8.27	8.89	0.62
LG C-1 5-10	5-10	8.68	8.99	0.31
LG C-1 10-15	10-15	8.96	8.98	0.02
LG C-1 15-20	15-20	9.04	9.04	0.00
LG C-2 0-5	0-5	8.45	8.92	0.47
LG C-2 5-10	5-10	8.71	8.71	0.00
LG C-2 10-15	10-15	8.76	8.63	-0.13
LG C-2 15-20	15-20	8.77	8.75	-0.02
LG C-3 0-5	0-5	8.32	8.54	0.22
LG C-3 5-10	5-10	8.61	8.76	0.15
LG C-3 10-15	10-15	8.79	8.78	-0.01
LG C-3 15-20	15-20	8.73	8.86	0.13

Table 14

Table 14. Water content of the two interspace distances (10 and 100 cm from the creosote bush) for each creosote bush compared. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3); r indicates radial distance from root; d indicates depth. Results are reported in g water/ 100 g dry soil. Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data do not provide evidence to support that the interspace soils vary significantly from each other at the 5% significance level.

Soil Sample ID	**Sampling Depth (cm)**	**Water Content (10 cm) (g water/ 100 g dry soil)**	**Water Content (100 cm) (g water/ 100 g dry soil)**	**Paired Difference (100 cm- 10 cm) (g water/ 100 g dry soil)**
Eldorado Valley				
EV C-1 0-5	0-5	0.42	0.19	-0.22
EV C-1 5-10	5-10	0.44	0.31	-0.13
EV C-1 10-15	20-15	0.44	0.39	-0.05
EV C-1 15-20	15-20	0.58	0.36	-0.21
EV C-2 0-5	0-5	0.46	0.41	-0.05
EV C-2 5-10	5-10	0.85	0.45	-0.40
EV C-2 10-15	10-15	1.53	0.55	-0.99
EV C-2 15-20	15-20	1.09	0.70	-0.39
EV C-3 0-5	0-5	0.46	0.44	-0.03
EV C-3 5-10	5-10	0.53	0.48	-0.04
EV C-3 10-15	10-15	0.54	0.81	0.27
EV C-3 15-20	15-20	1.17	1.09	-0.08
Lucy Gray				
LG C-1 0-5	0-5	0.35	0.34	-0.01
LG C-1 5-10	5-10	0.41	0.45	0.05
LG C-1 10-15	10-15	0.51	0.51	0.00
LG C-1 15-20	15-20	0.55	0.61	0.07
LG C-2 0-5	0-5	0.26	0.81	0.55
LG C-2 5-10	5-10	0.58	0.90	0.32
LG C-2 10-15	10-15	0.63	0.69	0.07
LG C-2 15-20	15-20	0.53	0.49	-0.05
LG C-3 0-5	0-5	0.55	0.69	0.14
LG C-3 5-10	5-10	0.70	0.85	0.16
LG C-3 10-15	10-15	0.81	1.10	0.29
LG C-3 15-20	15-20	0.93	1.23	0.31

Table 15

Table 15. Electrical conductance values of the two interspace distances (10 and 100 cm from the creosote bush) for each creosote bush compared. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3); r indicates radial distance from root; d indicates depth. Results are reported in µsiemens. Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data provide evidence that the interspace electrical conductivity values do vary significantly from each other at the 5% significance level, in which soils 100 cm from the plant have higher electrical conductance values than soils 10 cm from the plant.

Soil Sample ID	**Sampling Depth (cm)**	**EC (10 cm) (µsiemens)**	**EC (100 cm) (µsiemens)**	**Paired Difference (100 cm- 10 cm) (µsiemens)**
Eldorado Valley				
EV C-1 0-5	0-5	80.1	35.5	-44.6
EV C-1 5-10	5-10	75.6	45.9	-29.7
EV C-1 10-15	20-15	81.6	56.1	-25.5
EV C-1 15-20	15-20	79.6	45.2	-34.4
EV C-2 0-5	0-5	54.4	52	-2.4
EV C-2 5-10	5-10	53.4	59.2	5.8
EV C-2 10-15	10-15	57.9	68	10.1
EV C-2 15-20	15-20	70.8	52	-18.8
EV C-3 0-5	0-5	56	43	-13
EV C-3 5-10	5-10	60.2	30.4	-29.8
EV C-3 10-15	10-15	49.9	40.5	-9.4
EV C-3 15-20	15-20	84.4	34.9	-49.5
Lucy Gray				
LG C-1 0-5	0-5	72	84.6	12.6
LG C-1 5-10	5-10	74.3	47.6	-26.7
LG C-1 10-15	10-15	64.7	62.8	-1.9
LG C-1 15-20	15-20	60	71.2	11.2
LG C-2 0-5	0-5	193.2	62.8	-130.4
LG C-2 5-10	5-10	117	62	-55
LG C-2 10-15	10-15	109.7	65.8	-43.9
LG C-2 15-20	15-20	102.2	66.1	-36.1
LG C-3 0-5	0-5	154	73	-81
LG C-3 5-10	5-10	107.6	68.1	-39.5
LG C-3 10-15	10-15	95.6	70.8	-24.8
LG C-3 15-20	15-20	103.5	66.8	-36.7

Table 16

Table 16. Calcium from the exchangeable fraction released during the $BaCl_2$ digestion for soil samples from the rhizosphere samples compared to soils from the 10 cm interspace at depths up to 20 cm. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3). Results are reported in mmol Ca/g soil. Rhizosphere values are averaged from the exchangeable Ca content of two sampled roots. Paired t-tests were performed on the paired differences at a significance level of 0.05. The data provide evidence to support that the rhizosphere soils contain a greater amount of exchangeable Ca than the 10 cm distance interspace soils at the 5% significance level.

Soil Sample ID	**Sampling Depth (cm)**	**Rhizosphere (avg) (mmol Ca/g soil)**	**Interspace (10 cm) (mmol Ca/g soil)**	**Paired Difference (rhizosphere- interspace) (mmol Ca/g soil)**
Eldorado Valley				
EV C-1 0-5	0-5	0.025	0.018	0.007
EV C-1 5-10	5-10	0.022	0.018	0.005
EV C-1 10-15	10-15	0.020	0.016	0.004
EV C-1 15-20	15-20	0.017	0.015	0.002
EV C-2 0-5	0-5	0.017	0.017	0.001
EV C-2 10-15	10-15	0.016	0.016	0.000
EV C-3 0-5	0-5	0.027	0.021	0.006
EV C-3 10-15	10-15	0.024	0.015	0.009
Lucy Gray				
LG C-1 0-5	0-5	0.031	0.025	0.005
LG C-1 10-15	10-15	0.031	0.027	0.005
LG C-2 0-5	0-5	0.023	0.020	0.004
LG C-2 10-15	10-15	0.018	0.018	0.000
LG C-3 0-5	0-5	0.031	0.033	-0.002
LG C-3 10-15	10-15	0.028	0.031	-0.003

Table 17

Table 17. Calcium from the exchangeable fraction released during the $BaCl_2$ digestion for soil samples from the rhizosphere samples compared to soils from the 100 cm interspace at depths up to 20 cm. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3). Results are reported in mmol Ca/g soil. Rhizosphere values are averaged from the exchangeable Ca content of two sampled roots. Paired t-tests were performed on the paired differences at a significance level of 0.05. The data provide evidence to support that the rhizosphere soils contain a greater amount of exchangeable Ca than the 100 cm distance interspace soils at the 5% significance level.

Soil Sample ID	**Sampling Depth (cm)**	**Rhizosphere (avg) (mmol Ca/g soil)**	**Interspace (100 cm) (mmol Ca/g soil)**	**Paired Difference (rhizosphere-interspace) (mmol Ca/g soil)**
Eldorado Valley				
EV C-1 0-5	0-5	0.025	0.017	0.008
EV C-1 5-10	5-10	0.022	0.018	0.004
EV C-1 10-15	10-15	0.020	0.017	0.003
EV C-1 15-20	15-20	0.017	0.018	-0.001
EV C-2 0-5	0-5	0.017	0.017	0.001
EV C-2 10-15	10-15	0.016	0.016	-0.001
EV C-3 0-5	0-5	0.027	0.016	0.010
EV C-3 10-15	10-15	0.024	0.020	0.004
Lucy Gray				
LG C-1 0-5	0-5	0.031	0.023	0.007
LG C-1 10-15	10-15	0.031	0.025	0.006
LG C-2 0-5	0-5	0.023	0.017	0.007
LG C-2 10-15	10-15	0.018	0.016	0.002
LG C-3 0-5	0-5	0.031	0.028	0.003
LG C-3 10-15	10-15	0.028	0.028	0.001

Table 18

Table 18. Calcium from the $CaCO_3$ released during the CH_3OOH digestion for soil samples from the rhizosphere samples compared to soils from the 10 cm interspace at depths up to 20 cm. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3). Results are reported in weight % $CaCO_3$. Rhizosphere values are averaged from the exchangeable Ca content of two sampled roots. Paired t-tests were performed on the paired differences at a significance level of 0.05. The data provide evidence to support that the rhizosphere soils contain a greater amount of $CaCO_3$ than the 10 cm distance interspace soils at the 5% significance level.

Soil Sample ID	**Sampling Depth (cm)**	**Rhizosphere (avg) (weight % CaCO3)**	**Interspace (10 cm) (weight % CaCO3)**	**Paired Difference (interspace-rhizosphere) (weight % CaCO3)**
Eldorado Valley				
EV C-1 0-5	0-5	0.0029	0.0042	0.0014
EV C-1 5-10	5-10	0.0025	0.0034	0.0009
EV C-1 10-15	10-15	0.0033	0.0060	0.0026
EV C-1 15-20	15-20	0.0039	0.0053	0.0014
EV C-2 0-5	0-5	0.0066	0.0041	-0.0025
EV C-2 10-15	10-15	0.0048	0.0056	0.0008
EV C-3 0-5	0-5	0.0028	0.0024	-0.0004
EV C-3 10-15	10-15	0.0061	0.0073	0.0012
Lucy Gray				
LG C-1 0-5	0-5	0.0100	0.0155	0.0055
LG C-1 10-15	10-15	0.0197	0.0169	-0.0027
LG C-2 0-5	0-5	0.0066	0.0038	-0.0028
LG C-2 10-15	10-15	0.0073	0.0109	0.0037
LG C-3 0-5	0-5	0.0082	0.0151	0.0069
LG C-3 10-15	10-15	0.0116	0.0180	0.0064

Table 19

Table 19. Calcium from the $CaCO_3$ released during the CH_3OOH digestion for soil samples from the rhizosphere samples compared to soils from the 100 cm interspace at depths up to 20 cm. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3). Results are reported in weight & $CaCO_3$. Rhizosphere values are averaged from the $CaCO_3$ content of two sampled roots. Paired t-tests were performed on the paired differences at a significance level of 0.05. The data provide evidence to support that the rhizosphere soils contain a greater amount of $CaCO_3$ than the 100 cm distance interspace soils at the 5% significance level.

Soil Sample ID	**Sampling Depth (cm)**	**Rhizosphere (avg) (weight % CaCO3)**	**Interspace (100 cm) (weight % CaCO3)**	**Paired Difference (interspace-rhizosphere) (weight % CaCO3)**
Eldorado Valley				
EV C-1 0-5	0-5	0.0029	0.0160	0.0132
EV C-1 5-10	5-10	0.0025	0.0030	0.0005
EV C-1 10-15	10-15	0.0033	0.0043	0.0009
EV C-1 15-20	15-20	0.0039	0.0054	0.0015
EV C-2 0-5	0-5	0.0066	0.0055	-0.0011
EV C-2 10-15	10-15	0.0048	0.0041	-0.0007
EV C-3 0-5	0-5	0.0028	0.0026	-0.0002
EV C-3 10-15	10-15	0.0061	0.0044	-0.0017
Lucy Gray				
LG C-1 0-5	0-5	0.0100	0.0112	0.0012
LG C-1 10-15	10-15	0.0197	0.0200	0.0004
LG C-2 0-5	0-5	0.0066	0.0100	0.0034
LG C-2 10-15	10-15	0.0073	0.0092	0.0019
LG C-3 0-5	0-5	0.0082	0.0144	0.0063
LG C-3 10-15	10-15	0.0116	0.0183	0.0067

Table 20

Table 20. Amount of Ca from the exchangeable fraction from 10 cm interspace soils compared to 100 cm interspace soils. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3); r indicates radial distance from root; d indicates depth. Results are reported in mmol Ca/ g soil. Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data do not provide evidence that exchangeable Ca from soils from the 10 cm interspace differ significantly from the soils collected 100 cm from the creosote bush.

Soil Sample ID	**Sampling Depth**	**10 cm interspace (mmol Ca/g soil)**	**100 cm interspace (mmol Ca/g soil)**	**Paired Difference (mmol Ca/g soil)**
Eldorado Valley				
EV C-1 0-5	0-5	0.018	0.017	0.001
EV C-1 5-10	5-10	0.018	0.018	0.000
EV C-1 10-15	10-15	0.016	0.017	-0.001
EV C-1 15-20	15-20	0.015	0.018	-0.003
EV C-2 0-5	0-5	0.017	0.017	0.000
EV C-2 10-15	10-15	0.016	0.016	0.000
EV C-3 0-5	0-5	0.021	0.016	0.005
EV C-3 10-15	10-15	0.015	0.020	-0.005
Lucy Gray				
LG C-1 0-5	0-5	0.025	0.023	0.002
LG C-1 10-15	10-15	0.027	0.025	0.002
LG C-2 0-5	0-5	0.020	0.017	0.003
LG C-2 10-15	10-15	0.018	0.016	0.002
LG C-3 0-5	0-5	0.033	0.028	0.005
LG C-3 10-15	10-15	0.031	0.028	0.003

Table 21

Table 21. $CaCO_3$ from 10 cm interspace soils compared to 100 cm interspace soils. Soil sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3); r indicates radial distance from root; d indicates depth. Results are reported in weight % $CaCO_3$. Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data do not provide evidence that Ca from $CaCO_3$ from soils collected 10 cm from the creosote bush differ significantly from soils collected 100 cm from the creosote bush.

Soil Sample ID	**Sampling Depth**	**10 cm interspace (weight % CaCO3)**	**100 cm interspace (weight % CaCO3)**	**Paired Difference (weight % CaCO3)**
Eldorado Valley				
EV C-1 0-5	0-5	0.0042	0.0160	0.0118
EV C-1 5-10	5-10	0.0034	0.0030	-0.0004
EV C-1 10-15	10-15	0.0060	0.0043	-0.0017
EV C-1 15-20	15-20	0.0053	0.0054	0.0001
EV C-2 0-5	0-5	0.0041	0.0055	0.0014
EV C-2 10-15	10-15	0.0056	0.0041	-0.0015
EV C-3 0-5	0-5	0.0024	0.0026	0.0002
EV C-3 10-15	10-15	0.0073	0.0044	-0.0029
Lucy Gray				
LG C-1 0-5	0-5	0.0155	0.0112	-0.0043
LG C-1 10-15	10-15	0.0169	0.0200	0.0031
LG C-2 0-5	0-5	0.0038	0.0100	0.0062
LG C-2 10-15	10-15	0.0109	0.0092	-0.0018
LG C-3 0-5	0-5	0.0151	0.0144	-0.0007
LG C-3 10-15	10-15	0.0180	0.0183	0.0003

Table 22

Table 22. Combined Ca from the exchangeable fraction and from $CaCO_3$. Samples from the rhizosphere are compared to soil samples from 10 cm interspace soils. sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3); r indicates radial distance from root; d indicates depth. Results are reported in weight % $CaCO_3$. Results are reported in mmol Ca/ g soil. Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data do not provide evidence that combined Ca from the exchangeable fraction and from $CaCO_3$ differ significantly between rhizosphere soils and soils collected 10 cm from the creosote bush.

Soil Sample ID	**Sampling Depth (cm)**	**Rhizosphere (avg) (mmol Ca/g soil)**	**Interspace (10 cm) (mmol Ca/g soil)**	**Paired Difference (interspace-rhizosphere) (mmol Ca/g soil)**
Eldorado Valley				
EV C-1 0-5	0-5	0.053	0.060	0.007
EV C-1 5-10	5-10	0.047	0.051	0.004
EV C-1 10-15	10-15	0.053	0.076	0.022
EV C-1 15-20	15-20	0.056	0.068	0.012
EV C-2 0-5	0-5	0.083	0.057	-0.026
EV C-2 10-15	10-15	0.064	0.072	0.008
EV C-3 0-5	0-5	0.054	0.045	-0.009
EV C-3 10-15	10-15	0.085	0.088	0.003
Lucy Gray				
LG C-1 0-5	0-5	0.131	0.180	0.049
LG C-1 10-15	10-15	0.228	0.196	-0.032
LG C-2 0-5	0-5	0.089	0.058	-0.031
LG C-2 10-15	10-15	0.091	0.127	0.036
LG C-3 0-5	0-5	0.112	0.184	0.072
LG C-3 10-15	10-15	0.144	0.211	0.067

Table 23

Table 23. Combined Ca from the exchangeable fraction and from $CaCO_3$. Samples from the rhizosphere are compared to soil samples from 100 cm interspace soils. sample ID denotes creosote at which sample was taken (C-1, C-2, or C-3); r indicates radial distance from root; d indicates depth. Results are reported in weight % $CaCO_3$. Results are reported in mmol Ca/ g soil. Two-tailed paired t-tests were performed on the paired differences at a significance level of 0.05. The data do not provide evidence that combined Ca from the exchangeable fraction and from $CaCO_3$ differ significantly between rhizosphere soils and soils collected 100 cm from the creosote bush.

Soil Sample ID	**Sampling Depth (cm)**	**Rhizosphere (avg) (mmol Ca/g soil)**	**Interspace (100 cm) (mmol Ca/g soil)**	**Paired Difference (interspace-rhizosphere) (mmol Ca/g soil)**
Eldorado Valley				
EV C-1 0-5	0-5	0.053	0.177	0.124
EV C-1 5-10	5-10	0.047	0.048	0.000
EV C-1 10-15	10-15	0.053	0.060	0.007
EV C-1 15-20	15-20	0.056	0.072	0.016
EV C-2 0-5	0-5	0.083	0.071	-0.011
EV C-2 10-15	10-15	0.064	0.058	-0.006
EV C-3 0-5	0-5	0.054	0.042	-0.012
EV C-3 10-15	10-15	0.085	0.065	-0.020
Lucy Gray				
LG C-1 0-5	0-5	0.131	0.135	0.004
LG C-1 10-15	10-15	0.228	0.225	-0.003
LG C-2 0-5	0-5	0.089	0.117	0.028
LG C-2 10-15	10-15	0.091	0.108	0.017
LG C-3 0-5	0-5	0.112	0.172	0.060
LG C-3 10-15	10-15	0.144	0.211	0.066

Table 24

Table 24. Calcium from the exchangeable fraction for biological soil crust samples. Soil from directly underneath the crust is compared to adjacent non-crusted surface soil located several centimeters away from the crust. Paired t-tests were performed on the paired differences at a significance level of 0.05.. The data provide evidence to support that at a significance level of 5%, the adjacent non-crusted soils contain a greater amount of exchangeable Ca than the soils from beneath the biological soil crust.

Biological Soil Crust ID	**Soil from beneath Crust (mmol Ca/ g soil)**	**Adjacent Non-Crusted Soil (mmol Ca/g Soil)**	**Paired Difference (Adjacent Soil- Crust Soil) (mmol Ca/g Soil)**
Eldorado Valley			
EV Crust 1	0.015	0.016	0.001
EV Crust 2	0.013	0.016	0.003
EV Crust 3	0.015	0.018	0.003
Lucy Gray			
LG Crust 1	0.016	0.018	0.002
LG Crust 2	0.017	0.020	0.003
LG Crust 3	0.017	0.017	0.000

Table 25

Table 25. Calcium $CaCO_3$ for biological soil crust samples. Soil from directly underneath the crust is compared to adjacent non-crusted surface soil located several centimeters away from the crust. Paired t-tests were performed on the paired differences at a significance level of 0.05. The data do not provide evidence to support that at a significance level of 5%, the adjacent non-crusted soils contain a greater amount of $CaCO_3$ than the soils from beneath the biological soil crust, and therefore conclusions cannot be drawn from this data.

Biological Soil Crust ID	**Soil from beneath Crust (weight %)**	**Adjacent Non-Crusted Soil (weight %)**	**Paired Difference (Crust Soil- Adjacent) (weight %)**
Eldorado Valley			
EV Crust 1	0.0035	0.0023	0.0012
EV Crust 2	0.0059	0.0024	0.0036
EV Crust 3	0.0021	0.0028	-0.0007
Lucy Gray			
LG Crust 1	0.0021	0.0013	0.0008
LG Crust 2	0.0012	0.0024	-0.0012
LG Crust 3	0.0015	0.0009	0.0006

Table 26

Table 26. Dust collected at each site. Table shows collection surface (underneath a creosote bush canopy or in the plant interspaces), the amount of exchangeable Ca (mmol Ca/ g soil), and $CaCO_3$ content (in weight % $CaCO_3$).

Dust ID	**Collection Surface**	**Exchangeable Ca (mmol Ca/ g soil)**	**$CaCO_3$ (weight %)**
Eldorado Valley			
EV Dust 1	Interspace	0.016	0.0023
EV Dust 2	Interspace	0.016	0.0062
EV Dust 3	Under Shrub Canopy	0.017	0.0037
EV Dust 4	Under Shrub Canopy	0.025	0.0026
Lucy Gray			
LG Dust 1	Under Shrub Canopy	0.030	0.0039
LG Dust 2	Under Shrub Canopy	0.054	0.0035
LG Dust 3	Interspace	0.018	0.0020
LG Dust 4	Interspace	0.016	0.0023

Table 27

Table 27. Volume calculations for creosote bushes sampled. Calculations performed using length, width, and height measurements taken in the field. Volume is calculated as V= [illegible], in which length

Creosote Bush	**Measurements (m) and (m^2)**
Eldorado Valley	
Creosote Bush 1	
Length	1.7
Width	1.5
Height	1.0
Volume of Shrub	0.7
Creosote Bush 2	
Length	1.4
Width	1.3
Height	1.0
Volume of Shrub	0.5
Creosote Bush 3	
Length	1.4
Width	1.7
Height	0.8
Volume of Shrub	0.5
Lucy Gray	
Creosote Bush 1	
Length	0.9
Width	0.8
Height	0.9
Volume of Shrub	0.2
Creosote Bush 2	
Length	1.0
Width	1.2
Height	0.7
Volume of Shrub	0.2
Creosote Bush 2	
Length	1.2
Width	0.8
Height	0.6

Volume of Shrub	0.2

Table 28

Table 28. Total Ca in creosote bush tissue from each field site. Total Ca was calculated using canopy biomass and measured Ca content (mmol/g biomass). Live stems and dead stems have been combined for total Ca content.

Creosote Bush Tissue ID	**Biomass Averages (g)**	**Measured Ca Content (mmol Ca/g biomass)**	**Total Ca in tissues (mmol)**
Eldorado Valley			
Creosote Bush 1			
Leaves	234	0.031	7.3
Stems	2338	0.052	122
Dead Stems	1302	-	-
Roots	1979	0.061	121
Total Bush	5853		251
Creosote Bush 2			
Leaves	166	0.035	5.8
Stems	1662	0.021	34.7
Dead Stems	925	-	-
Roots	1407	0.029	41.5
Total Bush	4160		82
Creosote Bush 3			
Leaves	171	0.035	6.1
Stems	1714	0.026	44.3
Dead Stems	954	-	-
Roots	1451	0.042	60.5
Total Bush	4290		111
Lucy Gray			
Creosote Bush 1			
Leaves	58	0.027	1.6
Stems	583	0.011	6.2
Dead Stems	324	-	-
Roots	493	0.035	17.3
Total Bush	1458		25
Creosote Bush 2			
Leaves	72	0.027	2
Stems	720	0.012	8.8
Dead Stems	401	-	-
Roots	610	0.042	25.9

Total Bush	1803		37
Creosote Bush 3			
Leaves	52	0.036	1.9
Stems	517	0.017	8.8
Dead Stems	288	-	-
Roots	438	0.036	15.8
Total Bush	1295		27

Table 29

Table 29. Total exchangeable Ca in rhizosphere of one taproot from each creosote bush. Total exchangeable Ca was calculated using the volume of a cylinder ([redacted]), in which r is the 5 cm radius around the taproot that was sampled, and h is the minimum length of 1.5 m for a creosote bush taproot, as reported by Briones et al. (1996). All creosote specimens sampled for this study had at least 2 major roots extending from the crown.

Creosote Bush	**Average exchangeable Ca (mmol Ca/ 1 g soil) in Rhizosphere**	**Total Exchangeable Ca (mmol) in Rhizosphere of 1 Root**
Eldorado Valley		
Creosote Bush 1	0.021	425.02
Creosote Bush 2	0.016	322.79
Creosote Bush 3	0.022	438.55
Lucy Gray		
Creosote Bush 1	0.030	610.73
Creosote Bush 2	0.021	413.50
Creosote Bush 3	0.028	571.90

Table 30

Table 30. Total exchangeable Ca in rhizosphere of one taproot from each creosote bush compared to total Ca in each creosote bush. Greater amounts of exchangeable Ca are found in the rhizosphere as opposed to the creosote bushes, which implies that the shrubs are uptaking the Ca from the soil below. Total Ca in shrub not calculated for Lucy Gray "Creosote Bush 3."

Creosote Bush	**Total Exchangeable Ca (mmol) in Rhizosphere of 1 Root**	**Total Ca in Shrub (mmol)**
Eldorado Valley		
Creosote Bush 1	425.02	251
Creosote Bush 2	322.80	82
Creosote Bush 3	438.55	111
Lucy Gray		
Creosote Bush 1	610.73	25
Creosote Bush 2	413.50	37
Creosote Bush 3	571.90	27

Appendix C

Values of pH, EC and water content for all soil samples from Eldorado Valley (listed first) and Lucy Gray (listed second) field sites. Samples labeled “EV” are from Eldorado Valley, while those labeled “LG” are from Lucy Gray. “C” indicates the closest interspace sampling distance, 10 cm, “I” indicates the intermediate sampling distance 50 cm, and “F” indicates the furthest sampling distance, 100 cm. Rhizosphere and near-root samples are labeled with an “R.” Rhizosphere samples are labeled with “0-5r” before the depth, while near-root samples are labeled with “5-10r,” indicating the radius (in cm) around the root sampled. The latter numbers in the sample ID is the depth sampled.

ID	Max Depth (cm)	pH	EC (µsiemens)	Water Content (g water/ 100 g dry soil)
EV C-1 C 0-5	5.0	8.72	80.1	0.42
EV C-1 C 5-10	10.0	8.94	75.6	0.44
EV C-1 C 10-15	15.0	8.96	81.6	0.44
EV C-1 C 15-20	20.0	9.14	79.6	0.58
EV C-1 C 20-25	25.0	8.81	93.3	0.63
EV C-1 C 25-30	30.0	8.23	71	0.78
EV C-1 C 30-35	35.0	8.75	68.5	0.92
EV C-1 C 35-40	40.0	9.06	57.4	1.04
EV C-1 C 40-45	45.0	9.00	62	1.07
EV C-1 C 45-50	50.0	8.69	78.7	1.19
EV C-1 C 50-55	55.0	8.70	145.5	1.19
EV C-1 C 55-60	60.0	8.96	72.3	1.05
EV C-1 I 0-5	5.0	8.18	48.5	0.23
EV C-1 I 5-10	10.0	8.95	42.3	0.16
EV C-1 I 10-15	15.0	8.81	55.4	0.24
EV C-1 I 15-20	20.0	9.12	50.1	0.19
EV C-1 I 20-25	25.0	8.87	54.1	0.48
EV C-1 I 25-30	30.0	9.19	50.3	0.52
EV C-1 I 30-35	35.0	9.08	51.2	0.82
EV C-1 I 35-40	40.0	8.94	60.1	0.89
EV C-1 I 40-45	45.0	8.46	61.1	0.59
EV C-1 I 45-50	50.0	9.06	70.9	0.80
EV C-1 I 50-55	55.0	8.96	73.4	0.90
EV C-1 I 55-60	60.0	9.18	65.7	0.95
EV C-1 F 0-5	5.0	8.34	35.5	0.19
EV C-1 F 5-10	10.0	8.97	45.9	0.31
EV C-1 F 10-15	15.0	9.12	56.1	0.39
EV C-1 F 15-20	20.0	9.01	45.2	0.36

EV C-1 F 20-25	25.0	8.95	49.8	0.56
EV C-1 F 25-30	30.0	9.11	57.2	0.59
EV C-1 F 30-35	35.0	9	53.9	0.35
EV C-1 F 35-40	40.0	9.21	55.9	0.95
EV C-1 F 40-45	45.0	9.17	51.6	0.53
EV C-1 F 45-50	50.0	9.15	45.2	0.90
EV C-1 F 50-55	55.0	8.26	52	0.75
EV C-1 F 55-60	60.0	8.95	48.1	0.81
EV C-1, R-1, 0-5r, 0-5d	5.0	8.09	89	0.46
EV C-1, R-1, 0-5r, 5-10d	10.0	7.78	54.4	0.48
EV C-1, R-1, 0-5r, 10-15d	15.0	9.06	58.7	0.52
EV C-1, R-1, 0-5r, 15-20d	20.0	8.28	57.4	0.25
EV C-1, R-1, 5-10r, 0-5d	5.0	8.15	90.8	0.22
EV C-1, R-1, 5-10r, 5-10d	10.0	8.69	61	0.31
EV C-1, R-2, 0-5r, 0-5d	5.0	7.71	166.7	0.19
EV C-1, R-2, 0-5r, 5-10d	10.0	7.85	64.5	0.28
EV C-1, R-2, 0-5r,10-15d	15.0	7.76	49.4	0.29
EV C-1, R-2, 0-5r, 15-20d	20.0	8.07	48.3	0.33
EV C-2 C 0-5	5.0	8.52	56	0.46
EV C-2 C 5-10	10.0	8.79	60.2	0.85
EV C-2 C 10-15	15.0	8.86	49.9	1.53
EV C-2 C 15-20	20.0	8.13	84.4	1.09
EV C-2 C 20-25	25.0	8.51	172.4	1.64
EV C-2 C 25-30	30.0	8.27	200	0.69
EV C-2 C 30-35	35.0	8.51	200	0.62
EV C-2 C 35-40	40.0	8.37	200	0.48
EV C-2 C 40-45	45.0	8.29	200	0.58
EV C-2 C 45-50	50.0	8.08	200	0.51
EV C-2 C 50-55	55.0	8.26	200	0.39
EV C-2 C 55-60	60.0	8.47	200	0.41
EV C-2 I 0-5	5.0	8.1	67	0.48
EV C-2 I 5-10	10.0	8.72	45.9	0.69
EV C-2 I 10-15	15.0	9.01	87	0.52
EV C-2 I 15-20	20.0	8.96	45.6	0.50
EV C-2 I 20-25	25.0	8.71	43.5	0.71
EV C-2 I 25-30	30.0	9	54.9	1.00
EV C-2 I 30-35	35.0	8.85	46.6	0.44
EV C-2 I 35-40	40.0	8.87	39.2	0.53
EV C-2 I 40-45	45.0	8.83	41.9	0.46
EV C-2 I 45-50	50.0	8.74	29.9	0.51
EV C-2 I 50-55	55.0	8.92	46.6	0.67
EV C-2 I 55-60	60.0	8.56	49.7	0.36
EV C-2 F 0-5	5.0	8.67	43	0.41

EV C-2 F 5-10	10.0	8.91	30.4	0.45
EV C-2 F 10-15	15.0	8.88	40.5	0.55
EV C-2 F 15-20	20.0	8.52	34.9	0.70
EV C-2 F 20-25	25.0	8.5	35.9	0.52
EV C-2 F 25-30	30.0	8.93	26.8	0.51
EV C-2 F 30-35	35.0	8.93	36.6	0.61
EV C-2 F 35-40	40.0	8.52	53.9	0.49
EV C-2 F 40-45	45.0	8.27	50.1	0.41
EV C-2 F 45-50	50.0	8.87	42.6	0.48
EV C-2 F 50-55	55.0	8.9	36.8	0.47
EV C-2 F 55-60	60.0	8.86	39.7	0.45
EV C-2, R-1, 0-5r, 0-5d	5.0	8.55	54.1	0.33
EV C-2, R-1, 0-5r, 5-10d	10.0	8.4	54.1	0.53
EV C-2, R-1, 0-5r, 10-15d	15.0	8.43	48.5	0.49
EV C-2, R-1, 0-5r, 15-20d	20.0	8.71	57.8	0.30
EV C-2, R-1, 5-10r, 0-5d	5.0	8.32	56.4	0.46
EV C-2, R-1, 5-10r, 5-10d	10.0	8.24	134.9	0.88
EV C-2, R-1, 5-10r, 10-15d	15.0	8.56	116.6	0.66
EV C-2, R-1, 5-10r, 15-20d	20.0	8.88	45.6	0.61
EV C-2, R-2, 0-5r, 0-5d	5.0	8.31	90	0.49
EV C-2, R-2, 0-5r, 5-10d	10.0	8.64	66.3	0.76
EV C-2, R-2, 0-5r,10-15d	15.0	8.76	68	1.29
EV C-2, R-2, 0-5r, 15-20d	20.0	9.06	76.5	1.17
EV C-2, R-2, 5-10r, 0-5d	5.0	8.42	59.2	0.41
EV C-2, R-2, 5-10r, 5-10d	10.0	8.79	76.2	0.51
EV C-2, R-2, 5-10r, 10-15d	15.0	8.76	58	0.40
EV C-2, R-2, 5-10r, 15-20d	20.0	8.88	70.3	0.43
EV C-3 C 0-5	5.0	7.99	193.2	0.46
EV C-3 C 5-10	10.0	8.73	117	0.53
EV C-3 C 10-15	15.0	9.09	109.7	0.54
EV C-3 C 15-20	20.0	9.17	102.2	1.17
EV C-3 C 20-25	25.0	9.02	119.8	0.66
EV C-3 C 25-30	30.0	8.96	141.3	0.91
EV C-3 C 30-35	35.0	9.18	75	0.79
EV C-3 C 35-40	40.0	9.09	88.1	0.82
EV C-3 C 40-45	45.0	9.24	68.2	0.62
EV C-3 C 45-50	50.0	9.21	69.1	0.66
EV C-3 C 50-55	55.0	9.27	80.4	0.75
EV C-3 C 55-60	60.0	9.17	67.4	0.57
EV C-3 I 0-5	5.0	8.85	66	0.55
EV C-3 I 5-10	10.0	9.05	71.8	0.50
EV C-3 I 10-15	15.0	9.12	68.7	0.45
EV C-3 I 15-20	20.0	9.04	64.3	0.39

EV C-3 I 20-25	25.0	8.92	72.2	0.69
EV C-3 I 25-30	30.0	8.86	81	0.83
EV C-3 I 30-35	35.0	8.95	82.5	0.62
EV C-3 I 35-40	40.0	8.86	98	0.67
EV C-3 I 40-45	45.0	9	71.8	0.62
EV C-3 I 45-50	50.0	8.99	76.2	0.64
EV C-3 I 50-55	55.0	8.94	77.9	0.57
EV C-3 I 55-60	60.0	9.06	73	0.58
EV C-3 F 0-5	5.0	8.27	62.8	0.44
EV C-3 F 5-10	10.0	8.65	62	0.48
EV C-3 F 10-15	15.0	8.83	65.8	0.81
EV C-3 F 15-20	20.0	8.9	66.1	1.09
EV C-3 F 20-25	25.0	8.92	76.1	0.72
EV C-3 F 25-30	30.0	8.96	73.6	0.66
EV C-3 F 30-35	35.0	8.97	68.9	0.77
EV C-3 F 35-40	40.0	8.92	74	0.61
EV C-3 F 40-45	45.0	8.94	76.7	0.65
EV C-3 F 45-50	50.0	8.71	83	0.87
EV C-3 F 50-55	55.0	9.03	78.8	0.70
EV C-3 F 55-60	60.0	9	82.6	0.63
EV C-3, R-1, 0-5r, 0-5d	5.0	7.88	200	0.72
EV C-3, R-1, 0-5r, 5-10d	10.0	8.22	200	0.57
EV C-3, R-1, 0-5r, 10-15d	15.0	8.43	200	0.64
EV C-3, R-1, 0-5r, 15-20d	20.0	8.42	200	0.72
EV C-3, R-1, 5-10r, 0-5d	5.0	8.61	81.2	0.48
EV C-3, R-1, 5-10r, 5-10d	10.0	8.79	108.4	0.56
EV C-3, R-1, 5-10r, 10-15d	15.0	8.84	149.5	0.71
EV C-3, R-1, 5-10r, 15-20d	20.0	8.89	147.1	0.48
EV C-3, R-2, 0-5r, 0-5d	5.0	8.64	123.5	0.56
EV C-3, R-2, 0-5r, 5-10d	10.0	8.9	135.4	0.57
EV C-3, R-2, 0-5r,10-15d	15.0	8.86	132.5	0.52
EV C-3, R-2, 0-5r, 15-20d	20.0	8.66	200	1.10
EV C-3, R-2, 5-10r, 0-5d	5.0	8.45	112.5	0.48
EV C-3, R-2, 5-10r, 5-10d	10.0	8.86	112.7	0.53
EV C-3, R-2, 5-10r, 10-15d	15.0	8.91	135.2	0.51
EV C-3, R-2, 5-10r, 15-20d	20.0	8.66	194.3	0.64
LG C-1 C 0-5	5.0	8.27	54.4	0.35
LG C-1 C 5-10	10.0	8.68	53.4	0.41
LG C-1 C 10-15	15.0	8.96	57.9	0.51
LG C-1 C 15-20	20.0	9.04	70.8	0.55
LG C-1 C 20-25	25.0	9.04	86.4	0.64
LG C-1 C 25-30	30.0	9.12	76.9	0.54
LG C-1 C 30-35	35.0	8.66	73.4	0.63

LG C-1 I 0-5	5.0	8.57	65.3	0.30
LG C-1 I 5-10	10.0	8.76	55.4	0.44
LG C-1 I 10-15	15.0	8.87	50.9	0.48
LG C-1 I 15-20	20.0	8.95	54.9	0.53
LG C-1 I 20-25	25.0	9.02	70.7	2.01
LG C-1 I 25-30	30.0	9.01	60.6	1.18
LG C-1 I 30-35	35.0	8.96	58.3	1.07
LG C-1 I 35-40	40.0	8.9	76.7	0.73
LG C-1 F 0-5	5.0	8.89	52	0.34
LG C-1 F 5-10	10.0	8.99	59.2	0.45
LG C-1 F 10-15	15.0	8.98	68	0.51
LG C-1 F 15-20	20.0	9.04	52	0.61
LG C-1 F 20-25	25.0	9.04	57.6	0.84
LG C-1 F 25-30	30.0	9.07	58.4	0.86
LG C-1 F 30-35	35.0	9.08	68	0.87
LG C-1 R-1, 0-5r, 0-5d	5.0	8.16	52.6	0.36
LG C-1 R-1, 0-5r, 5-8d	8.0	8.67	55.8	0.43
LG C-1 R-1, 0-5r, 8-12d	12.0	8.88	72.4	0.41
LG C-1 R-1, 0-5r, 12-15d	15.0	8.96	61.3	0.51
LG C-1 R-1, 0-5r, 15-20d	20.0	8.93	59.8	0.65
LG C-1 R-2, 0-5r, 7.5r-12.5d	12.5	8.64	45.2	0.38
LG C-1 R-2, 0-5r, 12.5r-17.5d	17.5	8.92	51.8	0.45
LG C-1 R-2, 0-5r, 17.5r-22.5d	22.5	9.03	66.9	0.68
LG C-1 R-2, 0-5r, 22.5r-27.5d	27.5	8.9	63.8	0.40
LG C-1 R-3, 0-5r, 0-5d	5.0	8.51	95.3	0.39
LG C-1 R-3, 0-5r, 5-10d	10.0	8.75	78.8	0.49
LG C-1 R-3, 0-5r, 10-15d	15.0	8.96	64.5	0.60
LG C-1 R-3, 0-5r, 15-20d	20.0	8.98	61.9	0.62
LG C-1 R-3, 5-10r, 0-5d	5.0	8.89	57.8	0.38
LG C-1 R-3, 5-10r, 5-10d	10.0	9.01	60.1	0.47
LG C-1 R-3, 5-10r, 10-15d	15.0	9.09	74	0.59
LG C-1 R-3, 5-10r, 15-20d	20.0	9.09	74.1	0.60
LG C-2 C 0-5	5.0	8.45	72	0.26
LG C-2 C 5-10	10.0	8.71	74.3	0.58
LG C-2 C 10-15	15.0	8.76	64.7	0.63
LG C-2 C 15-20	20.0	8.77	60	0.53
LG C-2 C 20-25	25.0	8.69	61.5	0.33
LG C-2 C 25-30	30.0	8.84	104.4	0.40
LG C-2 C 30-35	35.0	8.52	63.2	0.75
LG C-2 C 35-40	40.0	8.69	39.4	0.63
LG C-2 C 40-45	45.0	8.65	54.6	0.78
LG C-2 C 45-50	50.0	8.58	48.6	0.62
LG C-2 C 50-55	55.0	8.62	48.4	0.48

LG C-2 C 55-60	60.0	8.72	32.4	0.74
LG C-2 I 0-5	5.0	8.3	39.2	0.27
LG C-2 I 5-10	10.0	8.52	46.5	0.47
LG C-2 I 10-15	15.0	8.59	48.3	0.63
LG C-2 I 15-20	20.0	8.49	41.5	0.36
LG C-2 I 20-25	25.0	8.65	49.6	0.63
LG C-2 I 25-30	30.0	8.67	48.7	0.61
LG C-2 I 30-35	35.0	8.61	47.7	0.61
LG C-2 I 35-40	40.0	8.71	51.5	0.30
LG C-2 I 40-45	45.0	8.64	46	0.42
LG C-2 I 45-50	50.0	8.77	38.2	0.35
LG C-2 I 50-55	55.0	8.64	21.8	0.19
LG C-2 I 55-60	60.0	8.54	30.5	0.29
LG C-2 F 0-5	5.0	8.92	84.6	0.81
LG C-2 F 5-10	10.0	8.71	47.6	0.90
LG C-2 F 10-15	15.0	8.63	62.8	0.69
LG C-2 F 15-20	20.0	8.75	71.2	0.49
LG C-2 F 20-25	25.0	8.55	43.3	0.41
LG C-2 F 25-30	30.0	8.05	29	0.44
LG C-2 F 30-35	35.0	8.65	42.9	0.37
LG C-2 F 35-40	40.0	8.52	50.2	0.48
LG C-2 F 40-45	45.0	8.39	44.4	0.55
LG C-2 F 45-50	50.0	8.58	32.8	0.42
LG C-2 F 50-55	55.0	8.17	46.7	0.59
LG C-2 F 55-60	60.0	8.68	40.7	0.56
LG C-2, R-1, 0-5r, 0-5d	5.0	8.48	188.5	0.54
LG C-2, R-1, 0-5r, 5-10d	10.0	8.7	66.4	0.33
LG C-2, R-1, 0-5r, 10-15d	15.0	8.71	72.3	0.55
LG C-2, R-1, 0-5r, 15-20d	20.0	8.68	67.2	0.48
LG C-2, R-1, 5-10r, 0-5d	5.0	8.63	69	0.60
LG C-2, R-1, 5-10r, 5-10d	10.0	8.63	75.2	-1.52
LG C-2, R-1, 5-10r, 10-15d	15.0	8.86	61.1	0.48
LG C-2, R-1, 5-10r, 15-20d	20.0	8.77	68	0.59
LG C-2, R-2, 0-5r, 0-5d	5.0	8.25	67.5	0.44
LG C-2, R-2, 0-5r, 5-10d	10.0	8.53	89.6	0.52
LG C-2, R-2, 0-5r,10-15d	15.0	8.65	61.5	0.21
LG C-2, R-2, 0-5r, 15-20d	20.0	8.83	79.2	0.51
LG C-2, R-2, 5-10r, 0-5d	5.0	8.37	86.3	9.54
LG C-2, R-2, 5-10r, 5-10d	10.0	8.7	50.2	0.49
LG C-2, R-2, 5-10r, 10-15d	15.0	8.81	41	0.55
LG C-2, R-2, 5-10r, 15-20d	20.0	8.88	64.2	0.52
LG C-3 C 0-5	5.0	8.32	154	0.55
LG C-3 C 5-10	10.0	8.61	107.6	0.70

LG C-3 C 10-15	15.0	8.79	95.6	0.81
LG C-3 C 15-20	20.0	8.73	103.5	0.93
LG C-3 C 20-25	25.0	8.81	83.3	1.27
LG C-3 C 25-30	30.0	8.42	89.9	0.86
LG C-3 C 30-35	35.0	8.71	91.8	0.98
LG C-3 C 35-40	40.0	8.64	81.3	0.89
LG C-3 C 40-45	45.0	8.71	85	0.85
LG C-3 C 45-50	50.0	8.71	83.1	1.12
LG C-3 C 50-55	55.0	8.7	75.2	1.10
LG C-3 C 55-60	60.0	8.66	80	1.54
LG C-3 I 0-5	5.0	8.52	90	0.68
LG C-3 I 5-10	10.0	8.62	80.7	0.74
LG C-3 I 10-15	15.0	8.98	74.2	1.22
LG C-3 I 15-20	20.0	8.99	77.2	1.21
LG C-3 I 20-25	25.0	9	73.1	1.17
LG C-3 I 25-30	30.0	8.94	73.8	0.88
LG C-3 I 30-35	35.0	8.78	81.9	1.17
LG C-3 I 35-40	40.0	8.27	87.3	0.99
LG C-3 I 40-45	45.0	8.2	173.6	0.78
LG C-3 I 45-50	50.0	8.83	91.5	0.98
LG C-3 I 50-55	55.0	8.98	82.2	0.91
LG C-3 I 55-60	60.0	8.93	85.9	1.01
LG C-3 F 0-5	5.0	8.54	73	0.69
LG C-3 F 5-10	10.0	8.76	68.1	0.85
LG C-3 F 10-15	15.0	8.78	70.8	1.10
LG C-3 F 15-20	20.0	8.86	66.8	1.23
LG C-3 F 20-25	25.0	8.66	79.7	1.15
LG C-3 F 25-30	30.0	8.7	78.1	1.34
LG C-3 F 30-35	35.0	8.7	69.8	0.68
LG C-3 F 35-40	40.0	8.78	81.9	1.35
LG C-3 F 40-45	45.0	8.68	75.7	1.18
LG C-3 F 45-50	50.0	8.72	77.6	0.95
LG C-3 F 50-55	55.0	8.73	71.5	1.34
LG C-3 F 55-60	60.0	8.73	67.1	1.06
LG C-3, R-1, 0-5r, 0-5d	5.0	8.12	104.3	0.77
LG C-3, R-1, 0-5r, 5-10d	10.0	8.29	78	0.68
LG C-3, R-1, 0-5r, 10-15d	15.0	8.19	82.5	0.71
LG C-3, R-1, 0-5r, 15-20d	20.0	8.19	73.1	0.90
LG C-3, R-1, 5-10r, 0-5d	5.0	8.52	117	0.57
LG C-3, R-1, 5-10r, 5-10d	10.0	8.76	92.3	0.80
LG C-3, R-1, 5-10r, 10-15d	15.0	8.85	89.4	0.87
LG C-3, R-1, 5-10r, 15-20d	20.0	8.84	74.2	0.78
LG C-3, R-2, 0-5r, 0-5d	5.0	8.52	101	0.81

LG C-3, R-2, 0-5r, 5-10d	10.0	8.37	84.6	0.79
LG C-3, R-2, 0-5r,10-15d	15.0	8.61	81.8	0.87
LG C-3, R-2, 0-5r, 15-20d	20.0	8.76	74.4	0.83
LG C-3, R-2, 5-10r, 0-5d	5.0	8.31	126.2	0.62
LG C-3, R-2, 5-10r, 5-10d	10.0	8.5	101.2	0.70
LG C-3, R-2, 5-10r, 10-15d	15.0	8.79	85.5	1.04
LG C-3, R-2, 5-10r, 15-20d	20.0	8.7	72.6	0.94

Values of Munsell color and corresponding soil color for all soil samples from Eldorado Valley (listed first) and Lucy Gray (listed second) field sites.

ID	Munsell Color	Soil Color
EV C-1 C 0-5	10 YR 5/4	yellowish brown
EV C-1 C 5-10	10 YR 5/4	yellowish brown
EV C-1 C 10-15	10 YR 5/4	yellowish brown
EV C-1 C 15-20	10 YR 5/4	yellowish brown
EV C-1 C 20-25	10 YR 5/4	yellowish brown
EV C-1 C 25-30	10 YR 5/3	brown
EV C-1 C 30-35	10 YR 5/3	brown
EV C-1 C 35-40	10 YR 5/4	yellowish brown
EV C-1 C 40-45	10 YR 5/4	yellowish brown
EV C-1 C 45-50	10 YR 5/4	yellowish brown
EV C-1 C 50-55	10 YR 5/4	yellowish brown
EV C-1 C 55-60	10 YR 5/4	yellowish brown
EV C-1 I 0-5	10 YR 5/4	yellowish brown
EV C-1 I 5-10	10 YR 5/4	yellowish brown
EV C-1 I 10-15	10 YR 5/4	yellowish brown
EV C-1 I 15-20	10 YR 5/3	brown
EV C-1 I 20-25	10 YR 5/4	yellowish brown
EV C-1 I 25-30	10 YR 5/4	yellowish brown
EV C-1 I 30-35	10 YR 5/4	yellowish brown
EV C-1 I 35-40	10 YR 5/4	yellowish brown
EV C-1 I 40-45	10 YR 5/4	yellowish brown
EV C-1 I 45-50	10 YR 5/4	yellowish brown
EV C-1 I 50-55	10 YR 5/3	brown
EV C-1 I 55-60	10 YR 5/4	yellowish brown
EV C-1 F 0-5	10 YR 5/3	brown
EV C-1 F 5-10	10 YR 5/4	yellowish brown
EV C-1 F 10-15	10 YR 5/4	yellowish brown
EV C-1 F 15-20	10 YR 5/4	yellowish brown
EV C-1 F 20-25	10 YR 5/4	yellowish brown
EV C-1 F 25-30	10 YR 5/4	yellowish brown
EV C-1 F 30-35	10 YR 5/4	yellowish brown
EV C-1 F 35-40	10 YR 5/4	yellowish brown
EV C-1 F 40-45	10 YR 5/4	yellowish brown
EV C-1 F 45-50	10 YR 5/3	brown

EV C-1 F 50-55	10 YR 5/3	brown
EV C-1 F 55-60	10 YR 5/4	yellowish brown
EV C-1, R-1, 0-5r, 0-5d	10 YR 5/4	yellowish brown
EV C-1, R-1, 0-5r, 5-10d	10 YR 5/4	yellowish brown
EV C-1, R-1, 0-5r, 10-15d	10 YR 5/4	yellowish brown
EV C-1, R-1, 0-5r, 15-20d	10 YR 5/4	yellowish brown
EV C-1, R-1, 5-10r, 0-5d	10 YR 5/4	yellowish brown
EV C-1, R-1, 5-10r, 5-10d	10 YR 5/4	yellowish brown
EV C-1, R-2, 0-5r, 0-5d	10 YR 5/3	brown
EV C-1, R-2, 0-5r, 5-10d	10 YR 5/3	brown
EV C-1, R-2, 0-5r,10-15d	10 YR 5/4	yellowish brown
LG C-1 C 0-5	10 YR 5/4	yellowish brown
LG C-1 C 5-10	10 YR 5/3	brown
LG C-1 C 10-15	10 YR 5/4	yellowish brown
LG C-1 C 15-20	10 YR 5/4	yellowish brown
LG C-1 C 20-25	10 YR 5/4	yellowish brown
LG C-1 C 25-30	10 YR 5/4	yellowish brown
LG C-1 C 30-35	10 YR 5/4	yellowish brown
LG C-1 I 0-5	10 YR 5/4	yellowish brown
LG C-1 I 5-10	10 YR 5/4	yellowish brown
LG C-1 I 10-15	10 YR 5/4	yellowish brown
LG C-1 I 15-20	10 YR 5/4	yellowish brown
LG C-1 I 20-25	10 YR 5/4	yellowish brown
LG C-1 I 25-30	10 YR 5/4	yellowish brown
LG C-1 I 30-35	10 YR 5/4	yellowish brown
LG C-1 I 35-40	10 YR 5/4	yellowish brown
LG C-1 F 0-5	10 YR 5/4	yellowish brown
LG C-1 F 5-10	10 YR 5/4	yellowish brown
LG C-1 F 10-15	10 YR 5/4	yellowish brown
LG C-1 F 15-20	10 YR 5/4	yellowish brown
LG C-1 F 20-25	10 YR 5/4	yellowish brown
LG C-1 F 25-30	10 YR 5/4	yellowish brown
LG C-1 F 30-35	10 YR 5/4	yellowish brown
LG C-1 R-1, 0-5r, 0-5d	10 YR 5/3	brown
LG C-1 R-1, 0-5r, 5-8d	10 YR 5/4	yellowish brown
LG C-1 R-1, 0-5r, 8-12d	10 YR 5/3	brown
LG C-1 R-1, 0-5r, 12-15d	10 YR 5/4	yellowish brown
LG C-1 R-1, 0-5r, 15-20d	10 YR 5/4	yellowish brown
LG C-1 R-2, 0-5r, 7.5r-12.5d	10 YR 5/4	yellowish brown
LG C-1 R-2, 0-5r, 12.5r-17.5d	10 YR 5/4	yellowish brown
LG C-1 R-2, 0-5r, 17.5r-22.5d	10 YR 5/4	yellowish brown
LG C-1 R-2, 0-5r, 22.5r-27.5d	10 YR 5/4	yellowish brown
LG C-1 R-3, 0-5r, 0-5d	10 YR 5/4	yellowish brown

LG C-1 R-3, 0-5r, 5-10d	10 YR 5/4	yellowish brown
LG C-1 R-3, 0-5r, 10-15d	10 YR 5/4	yellowish brown
LG C-1 R-3, 0-5r, 15-20d	10 YR 5/4	yellowish brown
LG C-1 R-3, 5-10r, 0-5d	10 YR 5/4	yellowish brown
LG C-1 R-3, 5-10r, 5-10d	10 YR 5/4	yellowish brown
LG C-1 R-3, 5-10r, 10-15d	10 YR 5/4	yellowish brown
LG C-1 R-3, 5-10r, 15-20d	10 YR 5/4	yellowish brown
EV C-2 C 0-5	10 YR 5/3	brown
EV C-2 C 5-10	10 YR 5/4	yellowish brown
EV C-2 C 10-15	10 YR 5/4	yellowish brown
EV C-2 C 15-20	10 YR 5/4	yellowish brown
EV C-2 C 20-25	10 YR 5/4	yellowish brown
EV C-2 C 25-30	10 YR 5/3	brown
EV C-2 C 30-35	10 YR 5/3	brown
EV C-2 C 35-40	10 YR 5/3	brown
EV C-2 C 40-45	10 YR 5/3	brown
EV C-2 C 45-50	10 YR 5/3	brown
EV C-2 C 50-55	10 YR 5/3	brown
EV C-2 C 55-60	10 YR 5/4	yellowish brown
EV C-2 I 0-5	10 YR 5/3	brown
EV C-2 I 5-10	10 YR 5/4	yellowish brown
EV C-2 I 10-15	10 YR 5/4	yellowish brown
EV C-2 I 15-20	10 YR 5/4	yellowish brown
EV C-2 I 20-25	10 YR 5/4	yellowish brown
EV C-2 I 25-30	10 YR 5/4	yellowish brown
EV C-2 I 30-35	10 YR 5/3	brown
EV C-2 I 35-40	10 YR 5/3	brown
EV C-2 I 40-45	10 YR 5/4	yellowish brown
EV C-2 I 45-50	10 YR 5/4	yellowish brown
EV C-2 I 50-55	10 YR 5/3	brown
EV C-2 I 55-60	10 YR 5/3	brown
EV C-2 F 0-5	10 YR 5/3	brown
EV C-2 F 5-10	10 YR 5/4	yellowish brown
EV C-2 F 10-15	10 YR 5/4	yellowish brown
EV C-2 F 15-20	10 YR 5/4	yellowish brown
EV C-2 F 20-25	10 YR 5/4	yellowish brown
EV C-2 F 25-30	10 YR 5/4	yellowish brown
EV C-2 F 30-35	10 YR 5/4	yellowish brown
EV C-2 F 35-40	10 YR 5/4	yellowish brown
EV C-2 F 40-45	10 YR 5/3	brown
EV C-2 F 45-50	10 YR 5/4	yellowish brown
EV C-2 F 50-55	10 YR 5/4	yellowish brown
EV C-2 F 55-60	10 YR 5/4	yellowish brown

EV C-2, R-1, 0-5r, 0-5d	10 YR 5/4	yellowish brown
EV C-2, R-1, 0-5r, 5-10d	10 YR 5/3	brown
EV C-2, R-1, 0-5r, 10-15d	10 YR 5/4	yellowish brown
EV C-2, R-1, 0-5r, 15-20d	10 YR 5/4	yellowish brown
EV C-2, R-1, 5-10r, 0-5d	10 YR 5/3	brown
EV C-2, R-1, 5-10r, 5-10d	10 YR 5/4	yellowish brown
EV C-2, R-1, 5-10r, 10-15d	10 YR 5/4	yellowish brown
EV C-2, R-1, 5-10r, 15-20d	10 YR 5/3	brown
EV C-2, R-2, 0-5r, 0-5d	10 YR 5/3	brown
EV C-2, R-2, 0-5r, 5-10d	10 YR 5/3	brown
EV C-2, R-2, 0-5r,10-15d	10 YR 5/3	brown
EV C-2, R-2, 0-5r, 15-20d	10 YR 5/4	yellowish brown
EV C-2, R-2, 5-10r, 0-5d	10 YR 5/3	brown
EV C-2, R-2, 5-10r, 5-10d	10 YR 5/3	brown
EV C-2, R-2, 5-10r, 10-15d	10 YR 5/4	yellowish brown
EV C-2, R-2, 5-10r, 15-20d	10 YR 5/4	yellowish brown
EV C-3 C 0-5	10 YR 5/4	yellowish brown
EV C-3 C 5-10	10 YR 6/4	light yellowish brown
EV C-3 C 10-15	10 YR 6/4	light yellowish brown
EV C-3 C 15-20	10 YR 6/4	light yellowish brown
EV C-3 C 20-25	10 YR 6/4	light yellowish brown
EV C-3 C 25-30	10 YR 6/4	light yellowish brown
EV C-3 C 30-35	10 YR 6/4	light yellowish brown
EV C-3 C 35-40	10 YR 6/4	light yellowish brown
EV C-3 C 40-45	10 YR 6/4	light yellowish brown
EV C-3 C 45-50	10 YR 6/4	light yellowish brown
EV C-3 C 50-55	10 YR 6/4	light yellowish brown
EV C-3 C 55-60	10 YR 6/4	light yellowish brown
EV C-3 I 0-5	10 YR 6/4	light yellowish brown
EV C-3 I 5-10	10 YR 6/4	light yellowish brown
EV C-3 I 10-15	10 YR 6/4	light yellowish brown
EV C-3 I 15-20	10 YR 6/4	light yellowish brown
EV C-3 I 20-25	10 YR 6/4	light yellowish brown
EV C-3 I 25-30	10 YR 6/4	light yellowish brown
EV C-3 I 30-35	10 YR 6/4	light yellowish brown
EV C-3 I 35-40	10 YR 6/4	light yellowish brown
EV C-3 I 40-45	10 YR 6/4	light yellowish brown
EV C-3 I 45-50	10 YR 6/4	light yellowish brown
EV C-3 I 50-55	10 YR 6/4	light yellowish brown
EV C-3 I 55-60	10 YR 6/4	light yellowish brown
EV C-3 F 0-5	10 YR 5/4	yellowish brown
EV C-3 F 5-10	10 YR 6/4	light yellowish brown
EV C-3 F 10-15	10 YR 6/4	light yellowish brown

EV C-3 F 15-20	10 YR 6/4	light yellowish brown
EV C-3 F 20-25	10 YR 6/4	light yellowish brown
EV C-3 F 25-30	10 YR 6/4	light yellowish brown
EV C-3 F 30-35	10 YR 6/4	light yellowish brown
EV C-3 F 35-40	10 YR 6/4	light yellowish brown
EV C-3 F 40-45	10 YR 6/4	light yellowish brown
EV C-3 F 45-50	10 YR 6/4	light yellowish brown
EV C-3 F 50-55	10 YR 6/4	light yellowish brown
EV C-3 F 55-60	10 YR 6/4	light yellowish brown
EV C-3, R-1, 0-5r, 0-5d	10 YR 4/4	dark yellowish brown
EV C-3, R-1, 0-5r, 5-10d	10 YR 5/4	yellowish brown
EV C-3, R-1, 0-5r, 10-15d	10 YR 5/4	yellowish brown
EV C-3, R-1, 0-5r, 15-20d	10 YR 5/4	yellowish brown
EV C-3, R-1, 5-10r, 0-5d	10 YR 5/4	yellowish brown
EV C-3, R-1, 5-10r, 5-10d	10 YR 5/4	yellowish brown
EV C-3, R-1, 5-10r, 10-15d	10 YR 5/4	yellowish brown
EV C-3, R-1, 5-10r, 15-20d	10 YR 5/4	yellowish brown
EV C-3, R-2, 0-5r, 0-5d	10 YR 5/4	yellowish brown
EV C-3, R-2, 0-5r, 5-10d	10 YR 5/4	yellowish brown
EV C-3, R-2, 0-5r,10-15d	10 YR 5/4	yellowish brown
EV C-3, R-2, 0-5r, 15-20d	10 YR 5/4	yellowish brown
EV C-3, R-2, 5-10r, 0-5d	10 YR 5/4	yellowish brown
EV C-3, R-2, 5-10r, 5-10d	10 YR 5/4	yellowish brown
EV C-3, R-2, 5-10r, 10-15d	10 YR 5/4	yellowish brown
EV C-3, R-2, 5-10r, 15-20d	10 YR 5/4	yellowish brown
LG C-1 C 0-5	10 YR 5/4	yellowish brown
LG C-1 C 5-10	10 YR 5/3	brown
LG C-1 C 10-15	10 YR 5/4	yellowish brown
LG C-1 C 15-20	10 YR 5/4	yellowish brown
LG C-1 C 20-25	10 YR 5/4	yellowish brown
LG C-1 C 25-30	10 YR 5/4	yellowish brown
LG C-1 C 30-35	10 YR 5/4	yellowish brown
LG C-1 I 0-5	10 YR 5/4	yellowish brown
LG C-1 I 5-10	10 YR 5/4	yellowish brown
LG C-1 I 10-15	10 YR 5/4	yellowish brown
LG C-1 I 15-20	10 YR 5/4	yellowish brown
LG C-1 I 20-25	10 YR 5/4	yellowish brown
LG C-1 I 25-30	10 YR 5/4	yellowish brown
LG C-1 I 30-35	10 YR 5/4	yellowish brown
LG C-1 I 35-40	10 YR 5/4	yellowish brown
LG C-1 F 0-5	10 YR 5/4	yellowish brown
LG C-1 F 5-10	10 YR 5/4	yellowish brown
LG C-1 F 10-15	10 YR 5/4	yellowish brown

LG C-1 F 15-20	10 YR 5/4	yellowish brown
LG C-1 F 20-25	10 YR 5/4	yellowish brown
LG C-1 F 25-30	10 YR 5/4	yellowish brown
LG C-1 F 30-35	10 YR 5/4	yellowish brown
LG C-1 R-1, 0-5r, 0-5d	10 YR 5/3	brown
LG C-1 R-1, 0-5r, 5-8d	10 YR 5/4	yellowish brown
LG C-1 R-1, 0-5r, 8-12d	10 YR 5/3	brown
LG C-1 R-1, 0-5r, 12-15d	10 YR 5/4	yellowish brown
LG C-1 R-1, 0-5r, 15-20d	10 YR 5/4	yellowish brown
LG C-1 R-2, 0-5r, 7.5r-12.5d	10 YR 5/4	yellowish brown
LG C-1 R-2, 0-5r, 12.5r-17.5d	10 YR 5/4	yellowish brown
LG C-1 R-2, 0-5r, 17.5r-22.5d	10 YR 5/4	yellowish brown
LG C-1 R-2, 0-5r, 22.5r-27.5d	10 YR 5/4	yellowish brown
LG C-1 R-3, 0-5r, 0-5d	10 YR 5/4	yellowish brown
LG C-1 R-3, 0-5r, 5-10d	10 YR 5/4	yellowish brown
LG C-1 R-3, 0-5r, 10-15d	10 YR 5/4	yellowish brown
LG C-1 R-3, 0-5r, 15-20d	10 YR 5/4	yellowish brown
LG C-1 R-3, 5-10r, 0-5d	10 YR 5/4	yellowish brown
LG C-1 R-3, 5-10r, 5-10d	10 YR 5/4	yellowish brown
LG C-1 R-3, 5-10r, 10-15d	10 YR 5/4	yellowish brown
LG C-1 R-3, 5-10r, 15-20d	10 YR 5/4	yellowish brown
LG C-2 C 0-5	10 YR 5/4	yellowish brown
LG C-2 C 5-10	10 YR 5/4	yellowish brown
LG C-2 C 10-15	10 YR 5/4	yellowish brown
LG C-2 C 15-20	10 YR 5/3	brown
LG C-2 C 20-25	10 YR 5/4	yellowish brown
LG C-2 C 25-30	10 YR 5/4	yellowish brown
LG C-2 C 30-35	10 YR 5/4	yellowish brown
LG C-2 C 35-40	10 YR 5/4	yellowish brown
LG C-2 C 40-45	10 YR 5/4	yellowish brown
LG C-2 C 45-50	10 YR 4/4	dark yellowish brown
LG C-2 C 50-55	10 YR 4/4	dark yellowish brown
LG C-2 C 55-60	10 YR 4/4	dark yellowish brown
LG C-2 I 0-5	10 YR 5/4	yellowish brown
LG C-2 I 5-10	10 YR 5/4	yellowish brown
LG C-2 I 10-15	10 YR 5/4	yellowish brown
LG C-2 I 15-20	10 YR 5/4	yellowish brown
LG C-2 I 20-25	10 YR 5/4	yellowish brown
LG C-2 I 25-30	10 YR 5/4	yellowish brown
LG C-2 I 30-35	10 YR 4/4	dark yellowish brown
LG C-2 I 35-40	10 YR 5/3	brown
LG C-2 I 40-45	10 YR 4/4	dark yellowish brown
LG C-2 I 45-50	10 YR 4/4	dark yellowish brown

LG C-2 I 50-55	10 YR 5/3	brown
LG C-2 I 55-60	10 YR 4/4	dark yellowish brown
LG C-2 F 0-5	10 YR 6/4	light yellowish brown
LG C-2 F 5-10	10 YR 6/4	light yellowish brown
LG C-2 F 10-15	10 YR 5/4	yellowish brown
LG C-2 F 15-20	10 YR 5/4	yellowish brown
LG C-2 F 20-25	10 YR 5/3	brown
LG C-2 F 25-30	10 YR 4/4	dark yellowish brown
LG C-2 F 30-35	10 YR 4/4	dark yellowish brown
LG C-2 F 35-40	10 YR 4/4	dark yellowish brown
LG C-2 F 40-45	10 YR 5/3	brown
LG C-2 F 45-50	10 YR 4/4	dark yellowish brown
LG C-2 F 50-55	10 YR 4/4	dark yellowish brown
LG C-2 F 55-60	10 YR 4/4	dark yellowish brown
LG C-2, R-1, 0-5r, 0-5d	10 YR 5/4	yellowish brown
LG C-2, R-1, 0-5r, 5-10d	10 YR 5/3	brown
LG C-2, R-1, 0-5r, 10-15d	10 YR 5/3	brown
LG C-2, R-1, 0-5r, 15-20d	10 YR 5/4	yellowish brown
LG C-2, R-1, 5-10r, 0-5d	10 YR 5/4	yellowish brown
LG C-2, R-1, 5-10r, 5-10d	10 YR 5/4	yellowish brown
LG C-2, R-1, 5-10r, 10-15d	10 YR 6/3	pale brown
LG C-2, R-1, 5-10r, 15-20d	10 YR 5/4	yellowish brown
LG C-2, R-2, 0-5r, 0-5d	10 YR 5/3	brown
LG C-2, R-2, 0-5r, 5-10d	10 YR 5/4	yellowish brown
LG C-2, R-2, 0-5r,10-15d	10 YR 5/4	yellowish brown
LG C-2, R-2, 0-5r, 15-20d	10 YR 5/4	yellowish brown
LG C-2, R-2, 5-10r, 0-5d	10 YR 5/4	yellowish brown
LG C-2, R-2, 5-10r, 5-10d	10 YR 5/4	yellowish brown
LG C-2, R-2, 5-10r, 10-15d	10 YR 5/4	yellowish brown
LG C-2, R-2, 5-10r, 15-20d	10 YR 5/4	yellowish brown
LG C-3 C 0-5	10 YR 6/4	light yellowish brown
LG C-3 C 5-10	10 YR 6/4	light yellowish brown
LG C-3 C 10-15	10 YR 6/4	light yellowish brown
LG C-3 C 15-20	10 YR 6/4	light yellowish brown
LG C-3 C 20-25	10 YR 6/4	light yellowish brown
LG C-3 C 25-30	10 YR 6/4	
LG C-3 C 30-35	10 YR 6/4	light yellowish brown
LG C-3 C 35-40	10 YR 6/4	light yellowish brown
LG C-3 C 40-45	10 YR 6/4	light yellowish brown
LG C-3 C 45-50	10 YR 6/4	light yellowish brown
LG C-3 C 50-55	10 YR 6/4	light yellowish brown
LG C-3 C 55-60	10 YR 6/4	light yellowish brown
LG C-3 I 0-5	10 YR 6/4	light yellowish brown

LG C-3 I 5-10	10 YR 6/4	light yellowish brown
LG C-3 I 10-15	10 YR 6/4	light yellowish brown
LG C-3 I 15-20	10 YR 6/4	light yellowish brown
LG C-3 I 20-25	10 YR 6/4	light yellowish brown
LG C-3 I 25-30	10 YR 6/4	light yellowish brown
LG C-3 I 30-35	10 YR 6/4	light yellowish brown
LG C-3 I 35-40	10 YR 6/4	light yellowish brown
LG C-3 I 40-45	10 YR 6/4	light yellowish brown
LG C-3 I 45-50	10 YR 6/4	light yellowish brown
LG C-3 I 50-55	10 YR 6/4	light yellowish brown
LG C-3 I 55-60	10 YR 6/4	light yellowish brown
LG C-3 F 0-5	10 YR 6/4	light yellowish brown
LG C-3 F 5-10	10 YR 6/4	light yellowish brown
LG C-3 F 10-15	10 YR 6/4	light yellowish brown
LG C-3 F 15-20	10 YR 6/4	light yellowish brown
LG C-3 F 20-25	10 YR 6/4	light yellowish brown
LG C-3 F 25-30	10 YR 6/4	light yellowish brown
LG C-3 F 30-35	10 YR 6/4	light yellowish brown
LG C-3 F 35-40	10 YR 6/4	light yellowish brown
LG C-3 F 40-45	10 YR 6/4	light yellowish brown
LG C-3 F 45-50	10 YR 6/4	light yellowish brown
LG C-3 F 50-55	10 YR 6/4	light yellowish brown
LG C-3 F 55-60	10 YR 6/4	light yellowish brown
LG C-3, R-1, 0-5r, 0-5d	10 YR 5/4	yellowish brown
LG C-3, R-1, 0-5r, 5-10d	10 YR 5/4	yellowish brown
LG C-3, R-1, 0-5r, 10-15d	10 YR 6/4	light yellowish brown
LG C-3, R-1, 0-5r, 15-20d	10 YR 6/4	light yellowish brown
LG C-3, R-1, 5-10r, 0-5d	10 YR 5/4	yellowish brown
LG C-3, R-1, 5-10r, 5-10d	10 YR 6/4	light yellowish brown
LG C-3, R-1, 5-10r, 10-15d	10 YR 6/4	light yellowish brown
LG C-3, R-1, 5-10r, 15-20d	10 YR 6/4	light yellowish brown
LG C-3, R-2, 0-5r, 0-5d	10 YR 5/4	yellowish brown
LG C-3, R-2, 0-5r, 5-10d	10 YR 6/4	light yellowish brown
LG C-3, R-2, 0-5r,10-15d	10 YR 6/4	light yellowish brown
LG C-3, R-2, 0-5r, 15-20d	10 YR 6/4	light yellowish brown
LG C-3, R-2, 5-10r, 0-5d	10 YR 5/4	yellowish brown
LG C-3, R-2, 5-10r, 5-10d	10 YR 5/4	yellowish brown
LG C-3, R-2, 5-10r, 10-15d	10 YR 6/4	light yellowish brown
LG C-3, R-2, 5-10r, 15-20d	10 YR 6/4	light yellowish brown

Appendix D

Calcium values for select soil samples from each extraction. Samples from $BaCl_2$ and HNO_3 extractions are reported as mmol Ca/ g soil; CH_3OOH samples are reported as weight % $CaCO_3$. Where no values are reported for a given sample, samples were collected from the field and analyzed for soil properties such as pH, water content, and electrical conductivity, but not subjected to sequential extractions.

ID	***$BaCl_2$***	***CH_3OOH***	***HNO_3***
EV C-1 C 0-5	0.018	0.0042	0.044
EV C-1 C 5-10	0.018	0.0034	0.032
EV C-1 C 10-15	0.016	0.0060	0.046
EV C-1 C 15-20	0.015	0.0053	0.033
EV C-1 C 20-25	0.021	0.0042	0.044
EV C-1 C 25-30	0.019	0.0062	0.045
EV C-1 C 30-35	0.018	0.0183	0.006
EV C-1 C 35-40	0.019	0.0054	0.049
EV C-1 C 40-45	0.032	0.0185	0.004
EV C-1 C 45-50	0.022	0.0077	0.039
EV C-1 C 50-55	0.020	0.0067	0.037
EV C-1 C 55-60	0.017	0.0093	0.039
EV C-1 I 0-5	0.018	0.0029	0.042
EV C-1 I 5-10	0.017	0.0058	0.041
EV C-1 I 10-15			
EV C-1 I 15-20	0.018	0.0058	0.047
EV C-1 I 20-25			
EV C-1 I 25-30	0.019	0.0045	0.045
EV C-1 I 30-35			
EV C-1 I 35-40	0.020	0.0093	0.046
EV C-1 I 40-45			
EV C-1 I 45-50	0.020	0.0186	0.039
EV C-1 I 50-55			
EV C-1 I 55-60	0.022	0.0166	0.044
EV C-1 F 0-5	0.038	0.0160	0.003
EV C-1 F 5-10	0.017	0.0030	0.027
EV C-1 F 10-15	0.018	0.0043	0.027
EV C-1 F 15-20	0.017	0.0054	0.040
EV C-1 F 20-25	0.018	0.0063	0.034
EV C-1 F 25-30	0.019	0.0121	0.039
EV C-1 F 30-35			
EV C-1 F 35-40	0.021	0.0083	0.027
EV C-1 F 40-45			

EV C-1 F 45-50	0.017	0.0072	0.040
EV C-1 F 50-55	0.018	0.0067	0.035
EV C-1 F 55-60	0.017	0.0081	0.045
EV C-1, R-1, 0-5r, 0-5d	0.021	0.0030	0.040
EV C-1, R-1, 0-5r, 5-10d	0.019	0.0020	0.039
EV C-1, R-1, 0-5r, 10-15d	0.019	0.0036	0.027
EV C-1, R-1, 0-5r, 15-20d	0.016	0.0043	0.038
EV C-1, R-1, 5-10r, 0-5d	0.020	0.0042	0.051
EV C-1, R-1, 5-10r, 5-10d	0.018	0.0046	0.041
EV C-1, R-2, 0-5r, 0-5d	0.028	0.0027	0.040
EV C-1, R-2, 0-5r, 5-10d	0.025	0.0030	0.049
EV C-1, R-2, 0-5r,10-15d	0.021	0.0030	0.038
EV C-1, R-2, 0-5r, 15-20d	0.019	0.0035	0.040
EV C-2 C 0-5	0.017	0.0041	0.039
EV C-2 C 5-10			
EV C-2 C 10-15	0.016	0.0056	0.045
EV C-2 C 15-20			
EV C-2 C 20-25	0.022	0.0132	0.044
EV C-2 C 25-30			
EV C-2 C 30-35	0.123	0.0154	0.046
EV C-2 C 35-40			
EV C-2 C 40-45	0.023	0.0072	0.044
EV C-2 C 45-50			
EV C-2 C 50-55	0.021	0.0067	0.045
EV C-2 C 55-60			
EV C-2 I 0-5			
EV C-2 I 5-10			
EV C-2 I 10-15			
EV C-2 I 15-20			
EV C-2 I 20-25			
EV C-2 I 25-30			
EV C-2 I 30-35			
EV C-2 I 35-40			
EV C-2 I 40-45			
EV C-2 I 45-50			
EV C-2 I 50-55			
EV C-2 I 55-60			
EV C-2 F 0-5	0.017	0.0055	0.037
EV C-2 F 5-10			
EV C-2 F 10-15	0.016	0.0041	0.040
EV C-2 F 15-20			
EV C-2 F 20-25	0.016	0.0067	0.025
EV C-2 F 25-30			

EV C-2 F 30-35	0.016	0.0052	0.022
EV C-2 F 35-40			
EV C-2 F 40-45	0.016	0.0050	0.039
EV C-2 F 45-50			
EV C-2 F 50-55	0.014	0.0049	0.021
EV C-2 F 55-60			
EV C-2, R-1, 0-5r, 0-5d	0.017	0.0079	0.040
EV C-2, R-1, 0-5r, 5-10d	0.017	0.0020	0.035
EV C-2, R-1, 0-5r, 10-15d	0.015	0.0027	0.029
EV C-2, R-1, 0-5r, 15-20d	0.015	0.0046	0.028
EV C-2, R-1, 5-10r, 0-5d			
EV C-2, R-1, 5-10r, 5-10d			
EV C-2, R-1, 5-10r, 10-15d			
EV C-2, R-1, 5-10r, 15-20d			
EV C-2, R-2, 0-5r, 0-5d	0.018	0.0052	0.044
EV C-2, R-2, 0-5r, 5-10d	0.015	0.0028	0.043
EV C-2, R-2, 0-5r, 10-15d	0.016	0.0070	0.043
EV C-2, R-2, 0-5r, 15-20d	0.015	0.0087	0.042
EV C-2, R-2, 5-10r, 0-5d			
EV C-2, R-2, 5-10r, 5-10d			
EV C-2, R-2, 5-10r, 10-15d			
EV C-2, R-2, 5-10r, 15-20d			
EV C-3 C 0-5	0.021	0.0024	0.048
EV C-3 C 5-10			
EV C-3 C 10-15	0.015	0.0073	0.050
EV C-3 C 15-20			
EV C-3 C 20-25	0.018	0.0072	0.041
EV C-3 C 25-30			
EV C-3 C 30-35	0.019	0.0078	0.035
EV C-3 C 35-40			
EV C-3 C 40-45	0.017	0.0077	0.042
EV C-3 C 45-50			
EV C-3 C 50-55	0.017	0.0076	0.036
EV C-3 C 55-60			
EV C-3 I 0-5			
EV C-3 I 5-10			
EV C-3 I 10-15			
EV C-3 I 15-20			
EV C-3 I 20-25			
EV C-3 I 25-30			
EV C-3 I 30-35			
EV C-3 I 35-40			
EV C-3 I 40-45			

EV C-3 I 45-50			
EV C-3 I 50-55			
EV C-3 I 55-60			
EV C-3 F 0-5	0.016	0.0026	0.045
EV C-3 F 5-10			
EV C-3 F 10-15	0.020	0.0044	0.040
EV C-3 F 15-20			
EV C-3 F 20-25	0.018	0.0074	0.033
EV C-3 F 25-30			
EV C-3 F 30-35	0.017	0.0068	0.029
EV C-3 F 35-40			
EV C-3 F 40-45	0.016	0.0074	0.030
EV C-3 F 45-50			
EV C-3 F 50-55	0.015	0.0063	0.033
EV C-3 F 55-60			
EV C-3, R-1, 0-5r, 0-5d	0.026	0.0017	0.039
EV C-3, R-1, 0-5r, 5-10d	0.021	0.0030	0.042
EV C-3, R-1, 0-5r, 10-15d	0.021	0.0042	0.035
EV C-3, R-1, 0-5r, 15-20d	0.021	0.0047	0.034
EV C-3, R-1, 5-10r, 0-5d			
EV C-3, R-1, 5-10r, 5-10d			
EV C-3, R-1, 5-10r, 10-15d			
EV C-3, R-1, 5-10r, 15-20d			
EV C-3, R-2, 0-5r, 0-5d	0.017	0.0038	0.046
EV C-3, R-2, 0-5r, 5-10d	0.019	0.0065	0.054
EV C-3, R-2, 0-5r, 10-15d	0.017	0.0080	0.050
EV C-3, R-2, 0-5r, 15-20d	0.032	0.0106	0.050
EV C-3, R-2, 5-10r, 0-5d			
EV C-3, R-2, 5-10r, 5-10d			
EV C-3, R-2, 5-10r, 10-15d			
EV C-3, R-2, 5-10r, 15-20d			
LG C-1 C 0-5	0.025	0.0155	0.049
LG C-1 C 5-10			
LG C-1 C 10-15	0.027	0.0169	0.047
LG C-1 C 15-20			
LG C-1 C 20-25	0.029	0.0245	0.051
LG C-1 C 25-30			
LG C-1 C 30-35	0.026	0.0238	0.039
LG C-1 I 0-5	0.026	0.0186	0.050
LG C-1 I 5-10			
LG C-1 I 10-15	0.031	0.0154	0.045
LG C-1 I 15-20			
LG C-1 I 20-25	0.029	0.0216	0.045

LG C-1 I 25-30			
LG C-1 I 30-35	0.030	0.0194	0.059
LG C-1 I 35-40			
LG C-1 F 0-5	0.023	0.0112	0.047
LG C-1 F 5-10			
LG C-1 F 10-15	0.025	0.0200	0.042
LG C-1 F 15-20			
LG C-1 F 20-25	0.029	0.0283	0.040
LG C-1 F 25-30			
LG C-1 F 30-35	0.027	0.0290	0.039
LG C-1 R-1, 0-5r, 0-5d	0.029	0.0116	0.067
LG C-1 R-1, 0-5r, 5-8d	0.030	0.0167	0.058
LG C-1 R-1 0-5r, 8-12d	0.026	0.0152	0.040
LG C-1 R-1, 0-5r, 12-15d	0.031	0.0161	0.047
LG C-1 R-1, 0-5r, 15-20d	0.032	0.0202	0.040
LG C-1 R-2, 0-5r, 7.5-12.5d	0.033	0.0136	0.080
LG C-1 R-2, 0-5r, 12.5-17.5d	0.029	0.0196	0.046
LG C-1 R-2, 0-5r, 17.5-22.5d	0.028	0.0242	0.047
LG C-1 R-2, 0-5r, 22.5-27.5d	0.033	0.0246	0.065
LG C-1 R-3, 0-5r, 0-5d	0.032	0.0084	0.041
LG C-1 R-3, 0-5r, 5-10d	0.030	0.0193	0.061
LG C-1 R-3, 0-5r, 10-15d	0.032	0.0233	0.060
LG C-1 R-3, 0-5r, 15-20d	0.030	0.0225	0.062
LG C-1 R-3, 5-10r, 0-5d	0.033	0.0184	0.055
LG C-1 R-3, 5-10r, 5-10d	0.027	0.0210	0.048
LG C-1 R-3, 5-10r, 10-15d	0.028	0.0278	0.059
LG C-1 R-3, 5-10r, 15-20d	0.028	0.0252	0.047
LG C-2 C 0-5	0.020	0.0038	0.054
LG C-2 C 5-10			
LG C-2 C 10-15	0.018	0.0109	0.026
LG C-2 C 15-20			
LG C-2 C 20-25	0.017	0.0108	0.040
LG C-2 C 25-30			
LG C-2 C 30-35	0.018	0.0117	0.049
LG C-2 C 35-40			
LG C-2 C 40-45	0.020	0.0047	0.033
LG C-2 C 45-50			
LG C-2 C 50-55	0.018	0.0032	0.034
LG C-2 C 55-60			
LG C-2 I 0-5			
LG C-2 I 5-10			
LG C-2 I 10-15			
LG C-2 I 15-20			

LG C-2 I 20-25			
LG C-2 I 25-30			
LG C-2 I 30-35			
LG C-2 I 35-40			
LG C-2 I 40-45			
LG C-2 I 45-50			
LG C-2 I 50-55			
LG C-2 I 55-60			
LG C-2 F 0-5	0.028	0.0100	0.027
LG C-2 F 5-10			
LG C-2 F 10-15	0.020	0.0092	0.041
LG C-2 F 15-20			
LG C-2 F 20-25	0.014	0.0035	0.054
LG C-2 F 25-30			
LG C-2 F 30-35	0.014	0.0035	0.039
LG C-2 F 35-40			
LG C-2 F 40-45	0.015	0.0034	0.048
LG C-2 F 45-50			
LG C-2 F 50-55	0.018	0.0023	0.046
LG C-2 F 55-60			
LG C-2, R-1, 0-5r, 0-5d	0.022	0.0095	0.052
LG C-2, R-1, 0-5r, 5-10d	0.019	0.0132	0.043
LG C-2, R-1, 0-5r, 10-15d	0.018	0.0086	0.035
LG C-2, R-1, 0-5r, 15-20d	0.019	0.0105	0.038
LG C-2, R-1, 5-10r, 0-5d			
LG C-2, R-1, 5-10r, 5-10d			
LG C-2, R-1, 5-10r, 10-15d			
LG C-2, R-1, 5-10r, 15-20d			
LG C-2, R-2, 0-5r, 0-5d	0.024	0.0037	0.027
LG C-2, R-2, 0-5r, 5-10d	0.024	0.0089	0.040
LG C-2, R-2, 0-5r, 10-15d	0.019	0.0059	0.029
LG C-2, R-2, 0-5r, 15-20d	0.019	0.0144	0.038
LG C-2, R-2, 5-10r, 0-5d			
LG C-2, R-2, 5-10r, 5-10d			
LG C-2, R-2, 5-10r, 10-15d			
LG C-2, R-2, 5-10r, 15-20d			
LG C-3 C 0-5	0.033	0.0151	0.046
LG C-3 C 5-10			
LG C-3 C 10-15	0.031	0.0180	0.049
LG C-3 C 15-20			
LG C-3 C 20-25	0.030	0.0254	0.052
LG C-3 C 25-30			
LG C-3 C 30-35	0.028	0.0276	0.047

LG C-3 C 35-40			
LG C-3 C 40-45	0.028	0.0294	0.055
LG C-3 C 45-50			
LG C-3 C 50-55	0.026	0.0267	0.051
LG C-3 C 55-60			
LG C-3 I 0-5			
LG C-3 I 5-10			
LG C-3 I 10-15			
LG C-3 I 15-20			
LG C-3 I 20-25			
LG C-3 I 25-30			
LG C-3 I 30-35			
LG C-3 I 35-40			
LG C-3 I 40-45			
LG C-3 I 45-50			
LG C-3 I 50-55			
LG C-3 I 55-60			
LG C-3 F 0-5	0.028	0.0144	0.054
LG C-3 F 5-10			
LG C-3 F 10-15	0.028	0.0183	0.057
LG C-3 F 15-20			
LG C-3 F 20-25	0.029	0.0262	0.038
LG C-3 F 25-30			
LG C-3 F 30-35	0.024	0.0191	0.046
LG C-3 F 35-40			
LG C-3 F 40-45	0.028	0.0289	0.062
LG C-3 F 45-50			
LG C-3 F 50-55	0.024	0.0186	0.058
LG C-3 F 55-60			
LG C-3, R-1, 0-5r, 0-5d	0.034	0.0066	0.043
LG C-3, R-1, 0-5r, 5-10d	0.027	0.0109	0.041
LG C-3, R-1, 0-5r, 10-15d	0.029	0.0125	0.058
LG C-3, R-1, 0-5r, 15-20d	0.028	0.0094	0.044
LG C-3, R-1, 5-10r, 0-5d			
LG C-3, R-1, 5-10r, 5-10d			
LG C-3, R-1, 5-10r, 10-15d			
LG C-3, R-1, 5-10r, 15-20d			
LG C-3, R-2, 0-5r, 0-5d	0.027	0.0097	0.045
LG C-3, R-2, 0-5r, 5-10d	0.032	0.0120	0.060
LG C-3, R-2, 0-5r, 10-15d	0.028	0.0107	0.042
LG C-3, R-2, 0-5r, 15-20d	0.023	0.0164	0.049
LG C-3, R-2, 5-10r, 0-5d			
LG C-3, R-2, 5-10r, 5-10d			

LG C-3, R-2, 5-10r, 10-15d
LG C-3, R-2, 5-10r, 15-20d

Appendix E

Calcium values for dust samples from each extraction. Samples from $BaCl_2$ and HNO_3 extractions are reported as mmol Ca/ g soil; CH_3OOH samples are reported as weight % $CaCO_3$.

ID	***$BaCl_2$***	***CH_3COOH***	***HNO_3***
Dust			
EV Dust 1 (interspace)	0.016	0.0023	0.038
EV Dust 2 (interspace)	0.016	0.0062	0.046
EV Dust 3 (under shrub)	0.017	0.0037	0.039
EV Dust 4 (under shrub)	0.025	0.0026	0.034
LG Dust 1 (under shrub)	0.030	0.0039	0.006
LG Dust 2 (under shrub)	0.054	0.0035	0.007
LG Dust 3 (interspace)	0.018	0.0020	0.007
LG Dust 4 (interspace)	0.016	0.0023	0.006

Appendix F

Spearman rank correlation tables for pH values compared against depth and organized by creosote bush. Spearman's rho (ρ) values are as follows: Eldorado Valley creosote bush 1, ρ = 0.444, Eldorado Valley creosote bush 2, ρ = 0.109, Eldorado Valley creosote bush 3, ρ = 0.667, Lucy Gray creosote bush 1, ρ = 0.602, Lucy Gray creosote bush 2, ρ = 0.005, Lucy Gray creosote bush 3, ρ = 0.349. A positive Spearman's rho indicates a positive correlation between the two variables, while a negative Spearman's rho indicates a negative correlation. If Spearman's rho is equal to 0, then no correlation exists between the variables. A Spearman's rho of 1 or -1 indicates a perfect monotonic correlation.

Sample ID	pH	Max Depth	Rank of pH	Rank of Depth
EV C-1 C 0-5	8.72	5.0	30	43.5
EV C-1 C 5-10	8.94	10.0	24.5	37.5
EV C-1 C 10-15	8.96	15.0	19	32
EV C-1 C 15-20	9.14	20.0	6	27
EV C-1 C 20-25	8.81	25.0	27.5	23
EV C-1 C 25-30	8.23	30.0	38	20
EV C-1 C 30-35	8.75	35.0	29	17
EV C-1 C 35-40	9.06	40.0	12	14
EV C-1 C 40-45	9.00	45.0	15.5	11
EV C-1 C 45-50	8.69	50.0	32.5	8
EV C-1 C 50-55	8.70	55.0	31	5
EV C-1 C 55-60	8.96	60.0	19	2
EV C-1 I 0-5	8.18	5.0	39	43.5
EV C-1 I 5-10	8.95	10.0	22	37.5
EV C-1 I 10-15	8.81	15.0	27.5	32
EV C-1 I 15-20	9.12	20.0	7.5	27
EV C-1 I 20-25	8.87	25.0	26	23
EV C-1 I 25-30	9.19	30.0	2	20
EV C-1 I 30-35	9.08	35.0	10	17
EV C-1 I 35-40	8.94	40.0	24.5	14
EV C-1 I 40-45	8.46	45.0	34	11
EV C-1 I 45-50	9.06	50.0	12	8
EV C-1 I 50-55	8.96	55.0	19	5
EV C-1 I 55-60	9.18	60.0	3	2
EV C-1 F 0-5	8.34	5.0	35	43.5
EV C-1 F 5-10	8.97	10.0	17	37.5
EV C-1 F 10-15	9.12	15.0	7.5	32
EV C-1 F 15-20	9.01	20.0	14	27
EV C-1 F 20-25	8.95	25.0	22	23
EV C-1 F 25-30	9.11	30.0	9	20
EV C-1 F 30-35	9	35.0	15.5	17
EV C-1 F 35-40	9.21	40.0	1	14
EV C-1 F 40-45	9.17	45.0	4	11
EV C-1 F 45-50	9.15	50.0	5	8
EV C-1 F 50-55	8.26	55.0	37	5

EV C-1 F 55-60	8.95	60.0	22	2
EV C-1, R-1, 0-5r, 0-5d	8.09	5.0	41	43.5
EV C-1, R-1, 0-5r, 5-10d	7.78	10.0	44	37.5
EV C-1, R-1, 0-5r, 10-15d	9.06	15.0	12	32
EV C-1, R-1, 0-5r, 15-20d	8.28	20.0	36	27
EV C-1, R-1, 5-10r, 0-5d	8.15	5.0	40	43.5
EV C-1, R-1, 5-10r, 5-10d	8.69	10.0	32.5	37.5
EV C-1, R-2, 0-5r, 0-5d	7.71	5.0	46	43.5
EV C-1, R-2, 0-5r, 5-10d	7.85	10.0	43	37.5
EV C-1, R-2, 0-5r,10-15d	7.76	15.0	45	32
EV C-1, R-2, 0-5r, 15-20d	8.07	20.0	42	27

Sample ID	pH	Max Depth	Rank of pH	Rank of Depth
EV C-2 C 0-5	8.52	5.0	33	49
EV C-2 C 5-10	8.79	10.0	19.5	42
EV C-2 C 10-15	8.86	15.0	15.5	35
EV C-2 C 15-20	8.13	20.0	50	28
EV C-2 C 20-25	8.51	25.0	35.5	23
EV C-2 C 25-30	8.27	30.0	46.5	20
EV C-2 C 30-35	8.51	35.0	35.5	17
EV C-2 C 35-40	8.37	40.0	42	14
EV C-2 C 40-45	8.29	45.0	45	11
EV C-2 C 45-50	8.08	50.0	52	8
EV C-2 C 50-55	8.26	55.0	48	5
EV C-2 C 55-60	8.47	60.0	38	2
EV C-2 I 0-5	8.1	5.0	51	49
EV C-2 I 5-10	8.72	10.0	24	42
EV C-2 I 10-15	9.01	15.0	2	35
EV C-2 I 15-20	8.96	20.0	4	28
EV C-2 I 20-25	8.71	25.0	25.5	23
EV C-2 I 25-30	9	30.0	3	20
EV C-2 I 30-35	8.85	35.0	17	17
EV C-2 I 35-40	8.87	40.0	13.5	14
EV C-2 I 40-45	8.83	45.0	18	11
EV C-2 I 45-50	8.74	50.0	23	8
EV C-2 I 50-55	8.92	55.0	7	5
EV C-2 I 55-60	8.56	60.0	29.5	2
EV C-2 F 0-5	8.67	5.0	27	49
EV C-2 F 5-10	8.91	10.0	8	42
EV C-2 F 10-15	8.88	15.0	11	35
EV C-2 F 15-20	8.52	20.0	33	28
EV C-2 F 20-25	8.5	25.0	37	23
EV C-2 F 25-30	8.93	30.0	5.5	20
EV C-2 F 30-35	8.93	35.0	5.5	17
EV C-2 F 35-40	8.52	40.0	33	14
EV C-2 F 40-45	8.27	45.0	46.5	11
EV C-2 F 45-50	8.87	50.0	13.5	8
EV C-2 F 50-55	8.9	55.0	9	5

EV C-2 F 55-60	8.86	60.0	15.5	2
EV C-2, R-1, 0-5r, 0-5d	8.55	5.0	31	49
EV C-2, R-1, 0-5r, 5-10d	8.4	10.0	41	42
EV C-2, R-1, 0-5r, 10-15d	8.43	15.0	39	35
EV C-2, R-1, 0-5r, 15-20d	8.71	20.0	25.5	28
EV C-2, R-1, 5-10r, 0-5d	8.32	5.0	43	49
EV C-2, R-1, 5-10r, 5-10d	8.24	10.0	49	42
EV C-2, R-1, 5-10r, 10-15d	8.56	15.0	29.5	35
EV C-2, R-1, 5-10r, 15-20d	8.88	20.0	11	28
EV C-2, R-2, 0-5r, 0-5d	8.31	5.0	44	49
EV C-2, R-2, 0-5r, 5-10d	8.64	10.0	28	42
EV C-2, R-2, 0-5r, 10-15d	8.76	15.0	21.5	35
EV C-2, R-2, 0-5r, 15-20d	9.06	20.0	1	28
EV C-2, R-2, 5-10r, 0-5d	8.42	5.0	40	49
EV C-2, R-2, 5-10r, 5-10d	8.79	10.0	19.5	42
EV C-2, R-2, 5-10r, 10-15d	8.76	15.0	21.5	35
EV C-2, R-2, 5-10r, 15-20d	8.88	20.0	11	28

Sample ID	**pH**	**Max Depth**	**Rank of pH**	**Rank of Depth**
EV C-3 C 0-5	7.99	5.0	51	49
EV C-3 C 5-10	8.73	10.0	39	42
EV C-3 C 10-15	9.09	15.0	8.5	35
EV C-3 C 15-20	9.17	20.0	5.5	28
EV C-3 C 20-25	9.02	25.0	14	23
EV C-3 C 25-30	8.96	30.0	19.5	20
EV C-3 C 30-35	9.18	35.0	4	17
EV C-3 C 35-40	9.09	40.0	8.5	14
EV C-3 C 40-45	9.24	45.0	2	11
EV C-3 C 45-50	9.21	50.0	3	8
EV C-3 C 50-55	9.27	55.0	1	5
EV C-3 C 55-60	9.17	60.0	5.5	2
EV C-3 I 0-5	8.85	5.0	35	49
EV C-3 I 5-10	9.05	10.0	11	42
EV C-3 I 10-15	9.12	15.0	7	35
EV C-3 I 15-20	9.04	20.0	12	28
EV C-3 I 20-25	8.92	25.0	25	23
EV C-3 I 25-30	8.86	30.0	32.5	20
EV C-3 I 30-35	8.95	35.0	21	17
EV C-3 I 35-40	8.86	40.0	32.5	14
EV C-3 I 40-45	9	45.0	15.5	11
EV C-3 I 45-50	8.99	50.0	17	8
EV C-3 I 50-55	8.94	55.0	22.5	5
EV C-3 I 55-60	9.06	60.0	10	2
EV C-3 F 0-5	8.27	5.0	49	49
EV C-3 F 5-10	8.65	10.0	43	42
EV C-3 F 10-15	8.83	15.0	37	35
EV C-3 F 15-20	8.9	20.0	28.5	28
EV C-3 F 20-25	8.92	25.0	25	23
EV C-3 F 25-30	8.96	30.0	19.5	20

EV C-3 F 30-35	8.97	35.0	18	17
EV C-3 F 35-40	8.92	40.0	25	14
EV C-3 F 40-45	8.94	45.0	22.5	11
EV C-3 F 45-50	8.71	50.0	40	8
EV C-3 F 50-55	9.03	55.0	13	5
EV C-3 F 55-60	9	60.0	15.5	2
EV C-3, R-1, 0-5r, 0-5d	7.88	5.0	52	49
EV C-3, R-1, 0-5r, 5-10d	8.22	10.0	50	42
EV C-3, R-1, 0-5r, 10-15d	8.43	15.0	47	35
EV C-3, R-1, 0-5r, 15-20d	8.42	20.0	48	28
EV C-3, R-1, 5-10r, 0-5d	8.61	5.0	45	49
EV C-3, R-1, 5-10r, 5-10d	8.79	10.0	38	42
EV C-3, R-1, 5-10r, 10-15d	8.84	15.0	36	35
EV C-3, R-1, 5-10r, 15-20d	8.89	20.0	30	28
EV C-3, R-2, 0-5r, 0-5d	8.64	5.0	44	49
EV C-3, R-2, 0-5r, 5-10d	8.9	10.0	28.5	42
EV C-3, R-2, 0-5r, 10-15d	8.86	15.0	32.5	35
EV C-3, R-2, 0-5r, 15-20d	8.66	20.0	41.5	28
EV C-3, R-2, 5-10r, 0-5d	8.45	5.0	46	49
EV C-3, R-2, 5-10r, 5-10d	8.86	10.0	32.5	42
EV C-3, R-2, 5-10r, 10-15d	8.91	15.0	27	35
EV C-3, R-2, 5-10r, 15-20d	8.66	20.0	41.5	28

Sample ID	**pH**	**Max Depth**	**Rank of pH**	**Rank of Depth**
LG C-1 C 0-5	8.27	5.0	38	36.5
LG C-1 C 5-10	8.68	10.0	32	30
LG C-1 C 10-15	8.96	15.0	18.5	22.5
LG C-1 C 15-20	9.04	20.0	7.5	15.5
LG C-1 C 20-25	9.04	25.0	7.5	10
LG C-1 C 25-30	9.12	30.0	1	6
LG C-1 C 30-35	8.66	35.0	34	3
LG C-1 I 0-5	8.57	5.0	36	36.5
LG C-1 I 5-10	8.76	10.0	30	30
LG C-1 I 10-15	8.87	15.0	29	22.5
LG C-1 I 15-20	8.95	20.0	21	15.5
LG C-1 I 20-25	9.02	25.0	11	10
LG C-1 I 25-30	9.01	30.0	12.5	6
LG C-1 I 30-35	8.96	35.0	18.5	3
LG C-1 I 35-40	8.9	40.0	24.5	1
LG C-1 F 0-5	8.89	5.0	26.5	36.5
LG C-1 F 5-10	8.99	10.0	14	30
LG C-1 F 10-15	8.98	15.0	15.5	22.5
LG C-1 F 15-20	9.04	20.0	7.5	15.5
LG C-1 F 20-25	9.04	25.0	7.5	10
LG C-1 F 25-30	9.07	30.0	5	6
LG C-1 F 30-35	9.08	35.0	4	3
LG C-1 R-1, 0-5r, 0-5d	8.16	5.0	39	36.5
LG C-1 R-1, 0-5r, 5-8d	8.67	8.0	33	33

LG C-1 R-1 0-5r, 8-12d	8.88	12.0	28	27
LG C-1 R-1, 0-5r, 12-15d	8.96	15.0	18.5	22.5
LG C-1 R-1, 0-5r, 15-20d	8.93	20.0	22	15.5
LG C-1 R-2, 0-5r, 7.5-12.5d	8.64	12.5	35	26
LG C-1 R-2, 0-5r, 12.5-17.5d	8.92	17.5	23	19
LG C-1 R-2, 0-5r, 17.5-22.5d	9.03	22.5	10	12
LG C-1 R-2, 0-5r, 22.5-27.5d	8.9	27.5	24.5	8
LG C-1 R-3, 0-5r, 0-5d	8.51	5.0	37	36.5
LG C-1 R-3, 0-5r, 5-10d	8.75	10.0	31	30
LG C-1 R-3, 0-5r, 10-15d	8.96	15.0	18.5	22.5
LG C-1 R-3, 0-5r, 15-20d	8.98	20.0	15.5	15.5
LG C-1 R-3, 5-10r, 0-5d	8.89	5.0	26.5	36.5
LG C-1 R-3, 5-10r, 5-10d	9.01	10.0	12.5	30
LG C-1 R-3, 5-10r, 10-15d	9.09	15.0	2.5	22.5
LG C-1 R-3, 5-10r, 15-20d	9.09	20.0	2.5	15.5

Sample ID	**pH**	**Max Depth**	**Rank of pH**	**Rank of Depth**
LG C-2 C 0-5	8.45	5.0	46	49
LG C-2 C 5-10	8.71	10.0	14.5	42
LG C-2 C 10-15	8.76	15.0	10	35
LG C-2 C 15-20	8.77	20.0	8	28
LG C-2 C 20-25	8.69	25.0	19.5	23
LG C-2 C 25-30	8.84	30.0	4	20
LG C-2 C 30-35	8.52	35.0	42	17
LG C-2 C 35-40	8.69	40.0	19.5	14
LG C-2 C 40-45	8.65	45.0	25.5	11
LG C-2 C 45-50	8.58	50.0	36.5	8
LG C-2 C 50-55	8.62	55.0	33	5
LG C-2 C 55-60	8.72	60.0	12	2
LG C-2 I 0-5	8.3	5.0	49	49
LG C-2 I 5-10	8.52	10.0	42	42
LG C-2 I 10-15	8.59	15.0	35	35
LG C-2 I 15-20	8.49	20.0	44	28
LG C-2 I 20-25	8.65	25.0	25.5	23
LG C-2 I 25-30	8.67	30.0	23	20
LG C-2 I 30-35	8.61	35.0	34	17
LG C-2 I 35-40	8.71	40.0	14.5	14
LG C-2 I 40-45	8.64	45.0	28.5	11
LG C-2 I 45-50	8.77	50.0	8	8
LG C-2 I 50-55	8.64	55.0	28.5	5
LG C-2 I 55-60	8.54	60.0	39	2
LG C-2 F 0-5	8.92	5.0	1	49
LG C-2 F 5-10	8.71	10.0	14.5	42
LG C-2 F 10-15	8.63	15.0	31	35
LG C-2 F 15-20	8.75	20.0	11	28
LG C-2 F 20-25	8.55	25.0	38	23
LG C-2 F 25-30	8.05	30.0	52	20
LG C-2 F 30-35	8.65	35.0	25.5	17
LG C-2 F 35-40	8.52	40.0	42	14

LG C-2 F 40-45	8.39	45.0	47	11
LG C-2 F 45-50	8.58	50.0	36.5	8
LG C-2 F 50-55	8.17	55.0	51	5
LG C-2 F 55-60	8.68	60.0	21.5	2
LG C-2, R-1, 0-5r, 0-5d	8.48	5.0	45	49
LG C-2, R-1, 0-5r, 5-10d	8.7	10.0	17.5	42
LG C-2, R-1, 0-5r, 10-15d	8.71	15.0	14.5	35
LG C-2, R-1, 0-5r, 15-20d	8.68	20.0	21.5	28
LG C-2, R-1, 5-10r, 0-5d	8.63	5.0	31	49
LG C-2, R-1, 5-10r, 5-10d	8.63	10.0	31	42
LG C-2, R-1, 5-10r, 10-15d	8.86	15.0	3	35
LG C-2, R-1, 5-10r, 15-20d	8.77	20.0	8	28
LG C-2, R-2, 0-5r, 0-5d	8.25	5.0	50	49
LG C-2, R-2, 0-5r, 5-10d	8.53	10.0	40	42
LG C-2, R-2, 0-5r, 10-15d	8.65	15.0	25.5	35
LG C-2, R-2, 0-5r, 15-20d	8.83	20.0	5	28
LG C-2, R-2, 5-10r, 0-5d	8.37	5.0	48	49
LG C-2, R-2, 5-10r, 5-10d	8.7	10.0	17.5	42
LG C-2, R-2, 5-10r, 10-15d	8.81	15.0	6	35
LG C-2, R-2, 5-10r, 15-20d	8.88	20.0	2	28

Sample ID	**pH**	**Max Depth**	**Rank of pH**	**Rank of Depth**
LG C-3 C 0-5	8.32	5.0	45	49
LG C-3 C 5-10	8.61	10.0	36.5	42
LG C-3 C 10-15	8.79	15.0	12.5	35
LG C-3 C 15-20	8.73	20.0	21	28
LG C-3 C 20-25	8.81	25.0	11	23
LG C-3 C 25-30	8.42	30.0	43	20
LG C-3 C 30-35	8.71	35.0	25	17
LG C-3 C 35-40	8.64	40.0	34	14
LG C-3 C 40-45	8.71	45.0	25	11
LG C-3 C 45-50	8.71	50.0	25	8
LG C-3 C 50-55	8.7	55.0	28.5	5
LG C-3 C 55-60	8.66	60.0	32.5	2
LG C-3 I 0-5	8.52	5.0	40	49
LG C-3 I 5-10	8.62	10.0	35	42
LG C-3 I 10-15	8.98	15.0	3.5	35
LG C-3 I 15-20	8.99	20.0	2	28
LG C-3 I 20-25	9	25.0	1	23
LG C-3 I 25-30	8.94	30.0	5	20
LG C-3 I 30-35	8.78	35.0	15	17
LG C-3 I 35-40	8.27	40.0	48	14
LG C-3 I 40-45	8.2	45.0	49	11
LG C-3 I 45-50	8.83	50.0	10	8
LG C-3 I 50-55	8.98	55.0	3.5	5
LG C-3 I 55-60	8.93	60.0	6	2
LG C-3 F 0-5	8.54	5.0	38	49
LG C-3 F 5-10	8.76	10.0	18	42

LG C-3 F 10-15	8.78	15.0	15	35
LG C-3 F 15-20	8.86	20.0	7	28
LG C-3 F 20-25	8.66	25.0	32.5	23
LG C-3 F 25-30	8.7	30.0	28.5	20
LG C-3 F 30-35	8.7	35.0	28.5	17
LG C-3 F 35-40	8.78	40.0	15	14
LG C-3 F 40-45	8.68	45.0	31	11
LG C-3 F 45-50	8.72	50.0	23	8
LG C-3 F 50-55	8.73	55.0	21	5
LG C-3 F 55-60	8.73	60.0	21	2
LG C-3, R-1, 0-5r, 0-5d	8.12	5.0	52	49
LG C-3, R-1, 0-5r, 5-10d	8.29	10.0	47	42
LG C-3, R-1, 0-5r, 10-15d	8.19	15.0	50.5	35
LG C-3, R-1, 0-5r, 15-20d	8.19	20.0	50.5	28
LG C-3, R-1, 5-10r, 0-5d	8.52	5.0	40	49
LG C-3, R-1, 5-10r, 5-10d	8.76	10.0	18	42
LG C-3, R-1, 5-10r, 10-15d	8.85	15.0	8	35
LG C-3, R-1, 5-10r, 15-20d	8.84	20.0	9	28
LG C-3, R-2, 0-5r, 0-5d	8.52	5.0	40	49
LG C-3, R-2, 0-5r, 5-10d	8.37	10.0	44	42
LG C-3, R-2, 0-5r, 10-15d	8.61	15.0	36.5	35
LG C-3, R-2, 0-5r, 15-20d	8.76	20.0	18	28
LG C-3, R-2, 5-10r, 0-5d	8.31	5.0	46	49
LG C-3, R-2, 5-10r, 5-10d	8.5	10.0	42	42
LG C-3, R-2, 5-10r, 10-15d	8.79	15.0	12.5	35
LG C-3, R-2, 5-10r, 15-20d	8.7	20.0	28.5	28

Appendix G

Spearman rank correlation tables for electrical conductance values compared against depth and organized by creosote bush. Electrical conductance values are reported in µsiemens. Spearman's rho (ρ) values are as follows: Eldorado Valley creosote bush 1, ρ = 0.020, Eldorado Valley creosote bush 2, ρ = -0.102, Eldorado Valley creosote bush 3, ρ = -0.286, Lucy Gray creosote bush 1, ρ = 0.326, Lucy Gray creosote bush 2, ρ = -0.621, Lucy Gray creosote bush 3, ρ = -0.291. A positive Spearman's rho indicates a positive correlation between the two variables, while a negative Spearman's rho indicates a negative correlation. If Spearman's rho is equal to 0, then no correlation exists between the variables. A Spearman's rho of 1 or -1 indicates a perfect monotonic correlation.

Sample ID	**Electrical Conductance (µsiemens)**	**Max Depth**	**Rank of EC**	**Rank of Depth**
EV C-1 C 0-5	80.1	5.0	7	43.5
EV C-1 C 5-10	75.6	10.0	10	37.5
EV C-1 C 10-15	81.6	15.0	6	32
EV C-1 C 15-20	79.6	20.0	8	27
EV C-1 C 20-25	93.3	25.0	3	23
EV C-1 C 25-30	71	30.0	13	20
EV C-1 C 30-35	68.5	35.0	15	17
EV C-1 C 35-40	57.4	40.0	23.5	14
EV C-1 C 40-45	62	45.0	18	11
EV C-1 C 45-50	78.7	50.0	9	8
EV C-1 C 50-55	145.5	55.0	2	5
EV C-1 C 55-60	72.3	60.0	12	2
EV C-1 I 0-5	48.5	5.0	39	43.5
EV C-1 I 5-10	42.3	10.0	45	37.5
EV C-1 I 10-15	55.4	15.0	28	32
EV C-1 I 15-20	50.1	20.0	36	27
EV C-1 I 20-25	54.1	25.0	30	23
EV C-1 I 25-30	50.3	30.0	35	20
EV C-1 I 30-35	51.2	35.0	34	17
EV C-1 I 35-40	60.1	40.0	21	14
EV C-1 I 40-45	61.1	45.0	19	11
EV C-1 I 45-50	70.9	50.0	14	8
EV C-1 I 50-55	73.4	55.0	11	5
EV C-1 I 55-60	65.7	60.0	16	2
EV C-1 F 0-5	35.5	5.0	46	43.5
EV C-1 F 5-10	45.9	10.0	42	37.5
EV C-1 F 10-15	56.1	15.0	26	32

EV C-1 F 15-20	45.2	20.0	43.5	27
EV C-1 F 20-25	49.8	25.0	37	23
EV C-1 F 25-30	57.2	30.0	25	20
EV C-1 F 30-35	53.9	35.0	31	17
EV C-1 F 35-40	55.9	40.0	27	14
EV C-1 F 40-45	51.6	45.0	33	11
EV C-1 F 45-50	45.2	50.0	43.5	8
EV C-1 F 50-55	52	55.0	32	5
EV C-1 F 55-60	48.1	60.0	41	2
EV C-1, R-1, 0-5r, 0-5d	89	5.0	5	43.5
EV C-1, R-1, 0-5r, 5-10d	54.4	10.0	29	37.5
EV C-1, R-1, 0-5r, 10-15d	58.7	15.0	22	32
EV C-1, R-1, 0-5r, 15-20d	57.4	20.0	23.5	27
EV C-1, R-1, 5-10r, 0-5d	90.8	5.0	4	43.5
EV C-1, R-1, 5-10r, 5-10d	61	10.0	20	37.5
EV C-1, R-2, 0-5r, 0-5d	166.7	5.0	1	43.5
EV C-1, R-2, 0-5r, 5-10d	64.5	10.0	17	37.5
EV C-1, R-2, 0-5r,10-15d	49.4	15.0	38	32
EV C-1, R-2, 0-5r, 15-20d	48.3	20.0	40	27

Sample ID	**Electrical Conductance (µsiemens)**	**Max Depth**	**Rank of EC**	**Rank of Depth**
EV C-2 C 0-5	56	5.0	25	49
EV C-2 C 5-10	60.2	10.0	20	42
EV C-2 C 10-15	49.9	15.0	31	35
EV C-2 C 15-20	84.4	20.0	13	28
EV C-2 C 20-25	172.4	25.0	8	23
EV C-2 C 25-30	200	30.0	4	20
EV C-2 C 30-35	200	35.0	4	17
EV C-2 C 35-40	200	40.0	4	14
EV C-2 C 40-45	200	45.0	4	11
EV C-2 C 45-50	200	50.0	4	8
EV C-2 C 50-55	200	55.0	4	5
EV C-2 C 55-60	200	60.0	4	2
EV C-2 I 0-5	67	5.0	18	49
EV C-2 I 5-10	45.9	10.0	36	42
EV C-2 I 10-15	87	15.0	12	35
EV C-2 I 15-20	45.6	20.0	37.5	28
EV C-2 I 20-25	43.5	25.0	39	23
EV C-2 I 25-30	54.9	30.0	26	20
EV C-2 I 30-35	46.6	35.0	34.5	17
EV C-2 I 35-40	39.2	40.0	45	14

EV C-2 I 40-45	41.9	45.0	42	11
EV C-2 I 45-50	29.9	50.0	51	8
EV C-2 I 50-55	46.6	55.0	34.5	5
EV C-2 I 55-60	49.7	60.0	32	2
EV C-2 F 0-5	43	5.0	40	49
EV C-2 F 5-10	30.4	10.0	50	42
EV C-2 F 10-15	40.5	15.0	43	35
EV C-2 F 15-20	34.9	20.0	49	28
EV C-2 F 20-25	35.9	25.0	48	23
EV C-2 F 25-30	26.8	30.0	52	20
EV C-2 F 30-35	36.6	35.0	47	17
EV C-2 F 35-40	53.9	40.0	29	14
EV C-2 F 40-45	50.1	45.0	30	11
EV C-2 F 45-50	42.6	50.0	41	8
EV C-2 F 50-55	36.8	55.0	46	5
EV C-2 F 55-60	39.7	60.0	44	2
EV C-2, R-1, 0-5r, 0-5d	54.1	5.0	27.5	49
EV C-2, R-1, 0-5r, 5-10d	54.1	10.0	27.5	42
EV C-2, R-1, 0-5r, 10-15d	48.5	15.0	33	35
EV C-2, R-1, 0-5r, 15-20d	57.8	20.0	23	28
EV C-2, R-1, 5-10r, 0-5d	56.4	5.0	24	49
EV C-2, R-1, 5-10r, 5-10d	134.9	10.0	9	42
EV C-2, R-1, 5-10r, 10-15d	116.6	15.0	10	35
EV C-2, R-1, 5-10r, 15-20d	45.6	20.0	37.5	28
EV C-2, R-2, 0-5r, 0-5d	90	5.0	11	49
EV C-2, R-2, 0-5r, 5-10d	66.3	10.0	19	42
EV C-2, R-2, 0-5r, 10-15d	68	15.0	17	35
EV C-2, R-2, 0-5r, 15-20d	76.5	20.0	14	28
EV C-2, R-2, 5-10r, 0-5d	59.2	5.0	21	49
EV C-2, R-2, 5-10r, 5-10d	76.2	10.0	15	42
EV C-2, R-2, 5-10r, 10-15d	58	15.0	22	35
EV C-2, R-2, 5-10r, 15-20d	70.3	20.0	16	28

Sample ID	**Electrical Conductance (µsiemens)**	**Max Depth**	**Rank of EC**	**Rank of Depth**
EV C-3 C 0-5	193.2	5.0	7	49
EV C-3 C 5-10	117	10.0	16	42
EV C-3 C 10-15	109.7	15.0	19	35
EV C-3 C 15-20	102.2	20.0	21	28
EV C-3 C 20-25	119.8	25.0	15	23
EV C-3 C 25-30	141.3	30.0	10	20
EV C-3 C 30-35	75	35.0	35	17

EV C-3 C 35-40	88.1	40.0	23	14
EV C-3 C 40-45	68.2	45.0	45	11
EV C-3 C 45-50	69.1	50.0	42	8
EV C-3 C 50-55	80.4	55.0	29	5
EV C-3 C 55-60	67.4	60.0	46	2
EV C-3 I 0-5	66	5.0	48	49
EV C-3 I 5-10	71.8	10.0	40.5	42
EV C-3 I 10-15	68.7	15.0	44	35
EV C-3 I 15-20	64.3	20.0	50	28
EV C-3 I 20-25	72.2	25.0	39	23
EV C-3 I 25-30	81	30.0	28	20
EV C-3 I 30-35	82.5	35.0	26	17
EV C-3 I 35-40	98	40.0	22	14
EV C-3 I 40-45	71.8	45.0	40.5	11
EV C-3 I 45-50	76.2	50.0	33	8
EV C-3 I 50-55	77.9	55.0	31	5
EV C-3 I 55-60	73	60.0	38	2
EV C-3 F 0-5	62.8	5.0	51	49
EV C-3 F 5-10	62	10.0	52	42
EV C-3 F 10-15	65.8	15.0	49	35
EV C-3 F 15-20	66.1	20.0	47	28
EV C-3 F 20-25	76.1	25.0	34	23
EV C-3 F 25-30	73.6	30.0	37	20
EV C-3 F 30-35	68.9	35.0	43	17
EV C-3 F 35-40	74	40.0	36	14
EV C-3 F 40-45	76.7	45.0	32	11
EV C-3 F 45-50	83	50.0	24	8
EV C-3 F 50-55	78.8	55.0	30	5
EV C-3 F 55-60	82.6	60.0	25	2
EV C-3, R-1, 0-5r, 0-5d	200	5.0	3	49
EV C-3, R-1, 0-5r, 5-10d	200	10.0	3	42
EV C-3, R-1, 0-5r, 10-15d	200	15.0	3	35
EV C-3, R-1, 0-5r, 15-20d	200	20.0	3	28
EV C-3, R-1, 5-10r, 0-5d	81.2	5.0	27	49
EV C-3, R-1, 5-10r, 5-10d	108.4	10.0	20	42
EV C-3, R-1, 5-10r, 10-15d	149.5	15.0	8	35
EV C-3, R-1, 5-10r, 15-20d	147.1	20.0	9	28
EV C-3, R-2, 0-5r, 0-5d	123.5	5.0	14	49
EV C-3, R-2, 0-5r, 5-10d	135.4	10.0	11	42
EV C-3, R-2, 0-5r, 10-15d	132.5	15.0	13	35
EV C-3, R-2, 0-5r, 15-20d	200	20.0	3	28
EV C-3, R-2, 5-10r, 0-5d	112.5	5.0	18	49
EV C-3, R-2, 5-10r, 5-10d	112.7	10.0	17	42

EV C-3, R-2, 5-10r, 10-15d	135.2	15.0	12	35
EV C-3, R-2, 5-10r, 15-20d	194.3	20.0	6	28

Sample ID	**Electrical Conductance (µsiemens)**	**Max Depth**	**Rank of EC**	**Rank of Depth**
LG C-1 C 0-5	54.4	5.0	32	36.5
LG C-1 C 5-10	53.4	10.0	33	30
LG C-1 C 10-15	57.9	15.0	26	22.5
LG C-1 C 15-20	70.8	20.0	10	15.5
LG C-1 C 20-25	86.4	25.0	2	10
LG C-1 C 25-30	76.9	30.0	4	6
LG C-1 C 30-35	73.4	35.0	8	3
LG C-1 I 0-5	65.3	5.0	15	36.5
LG C-1 I 5-10	55.4	10.0	30	30
LG C-1 I 10-15	50.9	15.0	38	22.5
LG C-1 I 15-20	54.9	20.0	31	15.5
LG C-1 I 20-25	70.7	25.0	11	10
LG C-1 I 25-30	60.6	30.0	20	6
LG C-1 I 30-35	58.3	35.0	25	3
LG C-1 I 35-40	76.7	40.0	5	1
LG C-1 F 0-5	52	5.0	35.5	36.5
LG C-1 F 5-10	59.2	10.0	23	30
LG C-1 F 10-15	68	15.0	12.5	22.5
LG C-1 F 15-20	52	20.0	35.5	15.5
LG C-1 F 20-25	57.6	25.0	28	10
LG C-1 F 25-30	58.4	30.0	24	6
LG C-1 F 30-35	68	35.0	12.5	3
LG C-1 R-1, 0-5r, 0-5d	52.6	5.0	34	36.5
LG C-1 R-1, 0-5r, 5-8d	55.8	8.0	29	33
LG C-1 R-1 0-5r, 8-12d	72.4	12.0	9	27
LG C-1 R-1, 0-5r, 12-15d	61.3	15.0	19	22.5
LG C-1 R-1, 0-5r, 15-20d	59.8	20.0	22	15.5
LG C-1 R-2, 0-5r, 7.5-12.5d	45.2	12.5	39	26
LG C-1 R-2, 0-5r, 12.5-17.5d	51.8	17.5	37	19
LG C-1 R-2, 0-5r, 17.5-22.5d	66.9	22.5	14	12
LG C-1 R-2, 0-5r, 22.5-27.5d	63.8	27.5	17	8
LG C-1 R-3, 0-5r, 0-5d	95.3	5.0	1	36.5
LG C-1 R-3, 0-5r, 5-10d	78.8	10.0	3	30
LG C-1 R-3, 0-5r, 10-15d	64.5	15.0	16	22.5
LG C-1 R-3, 0-5r, 15-20d	61.9	20.0	18	15.5
LG C-1 R-3, 5-10r, 0-5d	57.8	5.0	27	36.5
LG C-1 R-3, 5-10r, 5-10d	60.1	10.0	21	30

LG C-1 R-3, 5-10r, 10-15d	74	15.0	7	22.5
LG C-1 R-3, 5-10r, 15-20d	74.1	20.0	6	15.5

Sample ID	Electrical Conductance (μsiemens)	Max Depth	Rank of EC	Rank of Depth
LG C-2 C 0-5	72	5.0	10	49
LG C-2 C 5-10	74.3	10.0	8	42
LG C-2 C 10-15	64.7	15.0	17	35
LG C-2 C 15-20	60	20.0	24	28
LG C-2 C 20-25	61.5	25.0	21.5	23
LG C-2 C 25-30	104.4	30.0	2	20
LG C-2 C 30-35	63.2	35.0	19	17
LG C-2 C 35-40	39.4	40.0	45	14
LG C-2 C 40-45	54.6	45.0	25	11
LG C-2 C 45-50	48.6	50.0	31	8
LG C-2 C 50-55	48.4	55.0	32	5
LG C-2 C 55-60	32.4	60.0	49	2
LG C-2 I 0-5	39.2	5.0	46	49
LG C-2 I 5-10	46.5	10.0	37	42
LG C-2 I 10-15	48.3	15.0	33	35
LG C-2 I 15-20	41.5	20.0	42	28
LG C-2 I 20-25	49.6	25.0	29	23
LG C-2 I 25-30	48.7	30.0	30	20
LG C-2 I 30-35	47.7	35.0	34	17
LG C-2 I 35-40	51.5	40.0	26	14
LG C-2 I 40-45	46	45.0	38	11
LG C-2 I 45-50	38.2	50.0	47	8
LG C-2 I 50-55	21.8	55.0	52	5
LG C-2 I 55-60	30.5	60.0	50	2
LG C-2 F 0-5	84.6	5.0	5	49
LG C-2 F 5-10	47.6	10.0	35	42
LG C-2 F 10-15	62.8	15.0	20	35
LG C-2 F 15-20	71.2	20.0	11	28
LG C-2 F 20-25	43.3	25.0	40	23
LG C-2 F 25-30	29	30.0	51	20
LG C-2 F 30-35	42.9	35.0	41	17
LG C-2 F 35-40	50.2	40.0	27.5	14
LG C-2 F 40-45	44.4	45.0	39	11
LG C-2 F 45-50	32.8	50.0	48	8
LG C-2 F 50-55	46.7	55.0	36	5
LG C-2 F 55-60	40.7	60.0	44	2
LG C-2, R-1, 0-5r, 0-5d	188.5	5.0	1	49

LG C-2, R-1, 0-5r, 5-10d	66.4	10.0	16	42
LG C-2, R-1, 0-5r, 10-15d	72.3	15.0	9	35
LG C-2, R-1, 0-5r, 15-20d	67.2	20.0	15	28
LG C-2, R-1, 5-10r, 0-5d	69	5.0	12	49
LG C-2, R-1, 5-10r, 5-10d	75.2	10.0	7	42
LG C-2, R-1, 5-10r, 10-15d	61.1	15.0	23	35
LG C-2, R-1, 5-10r, 15-20d	68	20.0	13	28
LG C-2, R-2, 0-5r, 0-5d	67.5	5.0	14	49
LG C-2, R-2, 0-5r, 5-10d	89.6	10.0	3	42
LG C-2, R-2, 0-5r, 10-15d	61.5	15.0	21.5	35
LG C-2, R-2, 0-5r, 15-20d	79.2	20.0	6	28
LG C-2, R-2, 5-10r, 0-5d	86.3	5.0	4	49
LG C-2, R-2, 5-10r, 5-10d	50.2	10.0	27.5	42
LG C-2, R-2, 5-10r, 10-15d	41	15.0	43	35
LG C-2, R-2, 5-10r, 15-20d	64.2	20.0	18	28

Sample ID	**Electrical Conductance (µsiemens)**	**Max Depth**	**Rank of EC**	**Rank of Depth**
LG C-3 C 0-5	154	5.0	2	49
LG C-3 C 5-10	107.6	10.0	5	42
LG C-3 C 10-15	95.6	15.0	10	35
LG C-3 C 15-20	103.5	20.0	7	28
LG C-3 C 20-25	83.3	25.0	22	23
LG C-3 C 25-30	89.9	30.0	15	20
LG C-3 C 30-35	91.8	35.0	12	17
LG C-3 C 35-40	81.3	40.0	29	14
LG C-3 C 40-45	85	45.0	20	11
LG C-3 C 45-50	83.1	50.0	23	8
LG C-3 C 50-55	75.2	55.0	38	5
LG C-3 C 55-60	80	60.0	31	2
LG C-3 I 0-5	90	5.0	14	49
LG C-3 I 5-10	80.7	10.0	30	42
LG C-3 I 10-15	74.2	15.0	40.5	35
LG C-3 I 15-20	77.2	20.0	36	28
LG C-3 I 20-25	73.1	25.0	43.5	23
LG C-3 I 25-30	73.8	30.0	42	20
LG C-3 I 30-35	81.9	35.0	26.5	17
LG C-3 I 35-40	87.3	40.0	17	14
LG C-3 I 40-45	173.6	45.0	1	11
LG C-3 I 45-50	91.5	50.0	13	8
LG C-3 I 50-55	82.2	55.0	25	5

LG C-3 I 55-60	85.9	60.0	18	2
LG C-3 F 0-5	73	5.0	45	49
LG C-3 F 5-10	68.1	10.0	50	42
LG C-3 F 10-15	70.8	15.0	48	35
LG C-3 F 15-20	66.8	20.0	52	28
LG C-3 F 20-25	79.7	25.0	32	23
LG C-3 F 25-30	78.1	30.0	33	20
LG C-3 F 30-35	69.8	35.0	49	17
LG C-3 F 35-40	81.9	40.0	26.5	14
LG C-3 F 40-45	75.7	45.0	37	11
LG C-3 F 45-50	77.6	50.0	35	8
LG C-3 F 50-55	71.5	55.0	47	5
LG C-3 F 55-60	67.1	60.0	51	2
LG C-3, R-1, 0-5r, 0-5d	104.3	5.0	6	49
LG C-3, R-1, 0-5r, 5-10d	78	10.0	34	42
LG C-3, R-1, 0-5r, 10-15d	82.5	15.0	24	35
LG C-3, R-1, 0-5r, 15-20d	73.1	20.0	43.5	28
LG C-3, R-1, 5-10r, 0-5d	117	5.0	4	49
LG C-3, R-1, 5-10r, 5-10d	92.3	10.0	11	42
LG C-3, R-1, 5-10r, 10-15d	89.4	15.0	16	35
LG C-3, R-1, 5-10r, 15-20d	74.2	20.0	40.5	28
LG C-3, R-2, 0-5r, 0-5d	101	5.0	9	49
LG C-3, R-2, 0-5r, 5-10d	84.6	10.0	21	42
LG C-3, R-2, 0-5r, 10-15d	81.8	15.0	28	35
LG C-3, R-2, 0-5r, 15-20d	74.4	20.0	39	28
LG C-3, R-2, 5-10r, 0-5d	126.2	5.0	3	49
LG C-3, R-2, 5-10r, 5-10d	101.2	10.0	8	42
LG C-3, R-2, 5-10r, 10-15d	85.5	15.0	19	35
LG C-3, R-2, 5-10r, 15-20d	72.6	20.0	46	28

Appendix H

Spearman rank correlation tables for water content compared against depth and organized by creosote bush. Water content values are reported in g water/ 100 g dry soil. Spearman's rho (ρ) values are as follows: Eldorado Valley creosote bush 1, $\rho = 0.833$, Eldorado Valley creosote bush 2, $\rho = -0.105$, Eldorado Valley creosote bush 3, $\rho = 0.486$, Lucy Gray creosote bush 1, $\rho = 0.855$, Lucy Gray creosote bush 2, $\rho = -0.038$, Lucy Gray creosote bush 3, $\rho = 0.653$. A positive Spearman's rho indicates a positive correlation between the two variables, while a negative Spearman's rho indicates a negative correlation. If Spearman's rho is equal to 0, then no correlation exists between the variables. A Spearman's rho of 1 or -1 indicates a perfect monotonic correlation.

Sample ID	Water Content (g water/ 100 g dry soil)	Max Depth	Rank of Water Content	Rank of Depth
EV C-1 C 0-5	0.42	5.0	30	43.5
EV C-1 C 5-10	0.44	10.0	28	37.5
EV C-1 C 10-15	0.44	15.0	29	32
EV C-1 C 15-20	0.58	20.0	20	27
EV C-1 C 20-25	0.63	25.0	17	23
EV C-1 C 25-30	0.78	30.0	15	20
EV C-1 C 30-35	0.92	35.0	8	17
EV C-1 C 35-40	1.04	40.0	5	14
EV C-1 C 40-45	1.07	45.0	3	11
EV C-1 C 45-50	1.19	50.0	2	8
EV C-1 C 50-55	1.19	55.0	1	5
EV C-1 C 55-60	1.05	60.0	4	2
EV C-1 I 0-5	0.23	5.0	41	43.5
EV C-1 I 5-10	0.16	10.0	46	37.5
EV C-1 I 10-15	0.24	15.0	40	32
EV C-1 I 15-20	0.19	20.0	44	27
EV C-1 I 20-25	0.48	25.0	25	23
EV C-1 I 25-30	0.52	30.0	24	20
EV C-1 I 30-35	0.82	35.0	12	17
EV C-1 I 35-40	0.89	40.0	11	14
EV C-1 I 40-45	0.59	45.0	18	11
EV C-1 I 45-50	0.80	50.0	14	8
EV C-1 I 50-55	0.90	55.0	9	5
EV C-1 I 55-60	0.95	60.0	6	2
EV C-1 F 0-5	0.19	5.0	43	43.5
EV C-1 F 5-10	0.31	10.0	36	37.5
EV C-1 F 10-15	0.39	15.0	31	32
EV C-1 F 15-20	0.36	20.0	32	27

EV C-1 F 20-25	0.56	25.0	21	23
EV C-1 F 25-30	0.59	30.0	19	20
EV C-1 F 30-35	0.35	35.0	33	17
EV C-1 F 35-40	0.95	40.0	7	14
EV C-1 F 40-45	0.53	45.0	22	11
EV C-1 F 45-50	0.90	50.0	10	8
EV C-1 F 50-55	0.75	55.0	16	5
EV C-1 F 55-60	0.81	60.0	13	2
EV C-1, R-1, 0-5r, 0-5d	0.46	5.0	27	43.5
EV C-1, R-1, 0-5r, 5-10d	0.48	10.0	26	37.5
EV C-1, R-1, 0-5r, 10-15d	0.52	15.0	23	32
EV C-1, R-1, 0-5r, 15-20d	0.25	20.0	39	27
EV C-1, R-1, 5-10r, 0-5d	0.22	5.0	42	43.5
EV C-1, R-1, 5-10r, 5-10d	0.31	10.0	35	37.5
EV C-1, R-2, 0-5r, 0-5d	0.19	5.0	45	43.5
EV C-1, R-2, 0-5r, 5-10d	0.28	10.0	38	37.5
EV C-1, R-2, 0-5r,10-15d	0.29	15.0	37	32
EV C-1, R-2, 0-5r, 15-20d	0.33	20.0	34	27

Sample ID	**Water Content (g water/ 100 g dry soil)**	**Max Depth**	**Rank of Water Content**	**Rank of Depth**
EV C-2 C 0-5	0.46	5.0	37	49
EV C-2 C 5-10	0.85	10.0	8	42
EV C-2 C 10-15	1.54	15.0	2	35
EV C-2 C 15-20	1.09	20.0	5	28
EV C-2 C 20-25	1.64	25.0	1	23
EV C-2 C 25-30	0.69	30.0	13	20
EV C-2 C 30-35	0.62	35.0	16	17
EV C-2 C 35-40	0.48	40.0	34	14
EV C-2 C 40-45	0.58	45.0	19	11
EV C-2 C 45-50	0.51	50.0	27	8
EV C-2 C 50-55	0.39	55.0	49	5
EV C-2 C 55-60	0.41	60.0	45	2
EV C-2 I 0-5	0.49	5.0	33	49
EV C-2 I 5-10	0.69	10.0	12	42
EV C-2 I 10-15	0.52	15.0	23	35
EV C-2 I 15-20	0.50	20.0	29	28
EV C-2 I 20-25	0.71	25.0	10	23
EV C-2 I 25-30	1.00	30.0	6	20
EV C-2 I 30-35	0.44	35.0	42	17
EV C-2 I 35-40	0.53	40.0	22	14

EV C-2 I 40-45	0.46	45.0	39	11
EV C-2 I 45-50	0.51	50.0	26	8
EV C-2 I 50-55	0.67	55.0	14	5
EV C-2 I 55-60	0.36	60.0	50	2
EV C-2 F 0-5	0.41	5.0	47	49
EV C-2 F 5-10	0.45	10.0	41	42
EV C-2 F 10-15	0.55	15.0	20	35
EV C-2 F 15-20	0.70	20.0	11	28
EV C-2 F 20-25	0.52	25.0	24	23
EV C-2 F 25-30	0.51	30.0	28	20
EV C-2 F 30-35	0.61	35.0	18	17
EV C-2 F 35-40	0.49	40.0	31	14
EV C-2 F 40-45	0.41	45.0	46	11
EV C-2 F 45-50	0.48	50.0	35	8
EV C-2 F 50-55	0.47	55.0	36	5
EV C-2 F 55-60	0.45	60.0	40	2
EV C-2, R-1, 0-5r, 0-5d	0.33	5.0	51	49
EV C-2, R-1, 0-5r, 5-10d	0.53	10.0	21	42
EV C-2, R-1, 0-5r, 10-15d	0.49	15.0	30	35
EV C-2, R-1, 0-5r, 15-20d	0.31	20.0	52	28
EV C-2, R-1, 5-10r, 0-5d	0.46	5.0	38	49
EV C-2, R-1, 5-10r, 5-10d	0.88	10.0	7	42
EV C-2, R-1, 5-10r, 10-15d	0.66	15.0	15	35
EV C-2, R-1, 5-10r, 15-20d	0.61	20.0	17	28
EV C-2, R-2, 0-5r, 0-5d	0.49	5.0	32	49
EV C-2, R-2, 0-5r, 5-10d	0.76	10.0	9	42
EV C-2, R-2, 0-5r, 10-15d	1.29	15.0	3	35
EV C-2, R-2, 0-5r, 15-20d	1.17	20.0	4	28
EV C-2, R-2, 5-10r, 0-5d	0.41	5.0	44	49
EV C-2, R-2, 5-10r, 5-10d	0.51	10.0	25	42
EV C-2, R-2, 5-10r, 10-15d	0.40	15.0	48	35
EV C-2, R-2, 5-10r, 15-20d	0.43	20.0	43	28

Sample ID	**Water Content (g water/ 100 g dry soil)**	**Max Depth**	**Rank of Water Content**	**Rank of Depth**
EV C-3 C 0-5	0.47	5.0	49	49
EV C-3 C 5-10	0.53	10.0	41	42
EV C-3 C 10-15	0.54	15.0	39	35
EV C-3 C 15-20	1.17	20.0	1	28
EV C-3 C 20-25	0.66	25.0	19	23
EV C-3 C 25-30	0.91	30.0	4	20

EV C-3 C 30-35	0.79	35.0	9	17
EV C-3 C 35-40	0.83	40.0	7	14
EV C-3 C 40-45	0.62	45.0	28	11
EV C-3 C 45-50	0.66	50.0	21	8
EV C-3 C 50-55	0.75	55.0	11	5
EV C-3 C 55-60	0.57	60.0	33	2
EV C-3 I 0-5	0.55	5.0	38	49
EV C-3 I 5-10	0.50	10.0	44	42
EV C-3 I 10-15	0.45	15.0	50	35
EV C-3 I 15-20	0.39	20.0	52	28
EV C-3 I 20-25	0.70	25.0	17	23
EV C-3 I 25-30	0.83	30.0	6	20
EV C-3 I 30-35	0.62	35.0	29	17
EV C-3 I 35-40	0.67	40.0	18	14
EV C-3 I 40-45	0.63	45.0	27	11
EV C-3 I 45-50	0.64	50.0	25	8
EV C-3 I 50-55	0.57	55.0	32	5
EV C-3 I 55-60	0.58	60.0	31	2
EV C-3 F 0-5	0.44	5.0	51	49
EV C-3 F 5-10	0.48	10.0	46	42
EV C-3 F 10-15	0.81	15.0	8	35
EV C-3 F 15-20	1.09	20.0	3	28
EV C-3 F 20-25	0.72	25.0	12	23
EV C-3 F 25-30	0.66	30.0	20	20
EV C-3 F 30-35	0.77	35.0	10	17
EV C-3 F 35-40	0.61	40.0	30	14
EV C-3 F 40-45	0.65	45.0	22	11
EV C-3 F 45-50	0.87	50.0	5	8
EV C-3 F 50-55	0.70	55.0	16	5
EV C-3 F 55-60	0.63	60.0	26	2
EV C-3, R-1, 0-5r, 0-5d	0.72	5.0	13	49
EV C-3, R-1, 0-5r, 5-10d	0.57	10.0	35	42
EV C-3, R-1, 0-5r, 10-15d	0.64	15.0	24	35
EV C-3, R-1, 0-5r, 15-20d	0.72	20.0	14	28
EV C-3, R-1, 5-10r, 0-5d	0.48	5.0	47	49
EV C-3, R-1, 5-10r, 5-10d	0.56	10.0	36	42
EV C-3, R-1, 5-10r, 10-15d	0.72	15.0	15	35
EV C-3, R-1, 5-10r, 15-20d	0.48	20.0	45	28
EV C-3, R-2, 0-5r, 0-5d	0.56	5.0	37	49
EV C-3, R-2, 0-5r, 5-10d	0.57	10.0	34	42
EV C-3, R-2, 0-5r, 10-15d	0.52	15.0	42	35
EV C-3, R-2, 0-5r, 15-20d	1.10	20.0	2	28
EV C-3, R-2, 5-10r, 0-5d	0.48	5.0	48	49

EV C-3, R-2, 5-10r, 5-10d	0.53	10.0	40	42
EV C-3, R-2, 5-10r, 10-15d	0.51	15.0	43	35
EV C-3, R-2, 5-10r, 15-20d	0.64	20.0	23	28

Sample ID	Water Content (g water/ 100 g dry soil)	Max Depth	Rank of Water Content	Rank of Depth
LG C-1 C 0-5	0.35	5.0	37	36.5
LG C-1 C 5-10	0.41	10.0	31	30
LG C-1 C 10-15	0.51	15.0	21	22.5
LG C-1 C 15-20	0.55	20.0	17	15.5
LG C-1 C 20-25	0.64	25.0	10	10
LG C-1 C 25-30	0.54	30.0	18	6
LG C-1 C 30-35	0.63	35.0	11	3
LG C-1 I 0-5	0.31	5.0	39	36.5
LG C-1 I 5-10	0.44	10.0	28	30
LG C-1 I 10-15	0.48	15.0	24	22.5
LG C-1 I 15-20	0.53	20.0	19	15.5
LG C-1 I 20-25	2.01	25.0	1	10
LG C-1 I 25-30	1.18	30.0	2	6
LG C-1 I 30-35	1.07	35.0	3	3
LG C-1 I 35-40	0.73	40.0	7	1
LG C-1 F 0-5	0.34	5.0	38	36.5
LG C-1 F 5-10	0.46	10.0	26	30
LG C-1 F 10-15	0.51	15.0	20	22.5
LG C-1 F 15-20	0.61	20.0	13	15.5
LG C-1 F 20-25	0.84	25.0	6	10
LG C-1 F 25-30	0.86	30.0	5	6
LG C-1 F 30-35	0.87	35.0	4	3
LG C-1 R-1, 0-5r, 0-5d	0.37	5.0	36	36.5
LG C-1 R-1, 0-5r, 5-8d	0.43	8.0	29	33
LG C-1 R-1 0-5r, 8-12d	0.41	12.0	30	27
LG C-1 R-1, 0-5r, 12-15d	0.51	15.0	22	22.5
LG C-1 R-1, 0-5r, 15-20d	0.65	20.0	9	15.5
LG C-1 R-2, 0-5r, 7.5-12.5d	0.38	12.5	34	26
LG C-1 R-2, 0-5r, 12.5-17.5d	0.45	17.5	27	19
LG C-1 R-2, 0-5r, 17.5-22.5d	0.68	22.5	8	12
LG C-1 R-2, 0-5r, 22.5-27.5d	0.40	27.5	32	8
LG C-1 R-3, 0-5r, 0-5d	0.39	5.0	33	36.5
LG C-1 R-3, 0-5r, 5-10d	0.49	10.0	23	30

LG C-1 R-3, 0-5r, 10-15d	0.61	15.0	14	22.5
LG C-1 R-3, 0-5r, 15-20d	0.62	20.0	12	15.5
LG C-1 R-3, 5-10r, 0-5d	0.38	5.0	35	36.5
LG C-1 R-3, 5-10r, 5-10d	0.47	10.0	25	30
LG C-1 R-3, 5-10r, 10-15d	0.59	15.0	16	22.5
LG C-1 R-3, 5-10r, 15-20d	0.60	20.0	15	15.5

Sample ID	**Water Content (g water/ 100 g dry soil)**	**Max Depth**	**Rank of Water Content**	**Rank of Depth**
LG C-2 C 0-5	0.26	5.0	49	49
LG C-2 C 5-10	0.58	10.0	18	42
LG C-2 C 10-15	0.63	15.0	10	35
LG C-2 C 15-20	0.53	20.0	24	28
LG C-2 C 20-25	0.33	25.0	45	23
LG C-2 C 25-30	0.40	30.0	40	20
LG C-2 C 30-35	0.75	35.0	5	17
LG C-2 C 35-40	0.63	40.0	9	14
LG C-2 C 40-45	0.78	45.0	4	11
LG C-2 C 45-50	0.62	50.0	12	8
LG C-2 C 50-55	0.48	55.0	33	5
LG C-2 C 55-60	0.74	60.0	6	2
LG C-2 I 0-5	0.28	5.0	48	49
LG C-2 I 5-10	0.47	10.0	34	42
LG C-2 I 10-15	0.63	15.0	11	35
LG C-2 I 15-20	0.36	20.0	42	28
LG C-2 I 20-25	0.63	25.0	8	23
LG C-2 I 25-30	0.61	30.0	13	20
LG C-2 I 30-35	0.61	35.0	14	17
LG C-2 I 35-40	0.30	40.0	46	14
LG C-2 I 40-45	0.42	45.0	37	11
LG C-2 I 45-50	0.35	50.0	43	8
LG C-2 I 50-55	0.19	55.0	51	5
LG C-2 I 55-60	0.29	60.0	47	2
LG C-2 F 0-5	0.82	5.0	3	49
LG C-2 F 5-10	0.90	10.0	2	42
LG C-2 F 10-15	0.69	15.0	7	35
LG C-2 F 15-20	0.49	20.0	28	28
LG C-2 F 20-25	0.41	25.0	39	23
LG C-2 F 25-30	0.45	30.0	35	20
LG C-2 F 30-35	0.37	35.0	41	17

LG C-2 F 35-40	0.48	40.0	30	14
LG C-2 F 40-45	0.55	45.0	21	11
LG C-2 F 45-50	0.42	50.0	38	8
LG C-2 F 50-55	0.59	55.0	16	5
LG C-2 F 55-60	0.56	60.0	19	2
LG C-2, R-1, 0-5r, 0-5d	0.54	5.0	23	49
LG C-2, R-1, 0-5r, 5-10d	0.33	10.0	44	42
LG C-2, R-1, 0-5r, 10-15d	0.55	15.0	20	35
LG C-2, R-1, 0-5r, 15-20d	0.48	20.0	32	28
LG C-2, R-1, 5-10r, 0-5d	0.60	5.0	15	49
LG C-2, R-1, 5-10r, 5-10d	-1.52	10.0	52	42
LG C-2, R-1, 5-10r, 10-15d	0.48	15.0	31	35
LG C-2, R-1, 5-10r, 15-20d	0.59	20.0	17	28
LG C-2, R-2, 0-5r, 0-5d	0.44	5.0	36	49
LG C-2, R-2, 0-5r, 5-10d	0.52	10.0	25.5	42
LG C-2, R-2, 0-5r, 10-15d	0.21	15.0	50	35
LG C-2, R-2, 0-5r, 15-20d	0.51	20.0	27	28
LG C-2, R-2, 5-10r, 0-5d	9.54	5.0	1	49
LG C-2, R-2, 5-10r, 5-10d	0.49	10.0	29	42
LG C-2, R-2, 5-10r, 10-15d	0.55	15.0	22	35
LG C-2, R-2, 5-10r, 15-20d	0.52	20.0	25.5	28

Sample ID	Water Content (g water/ 100 g dry soil)	Max Depth	Rank of Water Content	Rank of Depth
LG C-3 C 0-5	0.55	5.0	52	49
LG C-3 C 5-10	0.70	10.0	45	42
LG C-3 C 10-15	0.81	15.0	35	35
LG C-3 C 15-20	0.93	20.0	24	28
LG C-3 C 20-25	1.27	25.0	5	23
LG C-3 C 25-30	0.86	30.0	31	20
LG C-3 C 30-35	0.98	35.0	21	17
LG C-3 C 35-40	0.89	40.0	27	14
LG C-3 C 40-45	0.85	45.0	32	11
LG C-3 C 45-50	1.12	50.0	13	8
LG C-3 C 50-55	1.10	55.0	15	5
LG C-3 C 55-60	1.54	60.0	1	2
LG C-3 I 0-5	0.68	5.0	49	49
LG C-3 I 5-10	0.74	10.0	42	42
LG C-3 I 10-15	1.22	15.0	7	35
LG C-3 I 15-20	1.21	20.0	8	28
LG C-3 I 20-25	1.17	25.0	11	23

LG C-3 I 25-30	0.88	30.0	28	20
LG C-3 I 30-35	1.17	35.0	10	17
LG C-3 I 35-40	0.99	40.0	19	14
LG C-3 I 40-45	0.78	45.0	39	11
LG C-3 I 45-50	0.98	50.0	20	8
LG C-3 I 50-55	0.91	55.0	25	5
LG C-3 I 55-60	1.01	60.0	18	2
LG C-3 F 0-5	0.69	5.0	46	49
LG C-3 F 5-10	0.85	10.0	33	42
LG C-3 F 10-15	1.10	15.0	14	35
LG C-3 F 15-20	1.24	20.0	6	28
LG C-3 F 20-25	1.15	25.0	12	23
LG C-3 F 25-30	1.34	30.0	4	20
LG C-3 F 30-35	0.68	35.0	47	17
LG C-3 F 35-40	1.35	40.0	2	14
LG C-3 F 40-45	1.18	45.0	9	11
LG C-3 F 45-50	0.95	50.0	22	8
LG C-3 F 50-55	1.34	55.0	3	5
LG C-3 F 55-60	1.06	60.0	16	2
LG C-3, R-1, 0-5r, 0-5d	0.77	5.0	41	49
LG C-3, R-1, 0-5r, 5-10d	0.68	10.0	48	42
LG C-3, R-1, 0-5r, 10-15d	0.71	15.0	43	35
LG C-3, R-1, 0-5r, 15-20d	0.90	20.0	26	28
LG C-3, R-1, 5-10r, 0-5d	0.58	5.0	51	49
LG C-3, R-1, 5-10r, 5-10d	0.80	10.0	37	42
LG C-3, R-1, 5-10r, 10-15d	0.87	15.0	30	35
LG C-3, R-1, 5-10r, 15-20d	0.78	20.0	40	28
LG C-3, R-2, 0-5r, 0-5d	0.81	5.0	36	49
LG C-3, R-2, 0-5r, 5-10d	0.79	10.0	38	42
LG C-3, R-2, 0-5r, 10-15d	0.87	15.0	29	35
LG C-3, R-2, 0-5r, 15-20d	0.83	20.0	34	28
LG C-3, R-2, 5-10r, 0-5d	0.62	5.0	50	49
LG C-3, R-2, 5-10r, 5-10d	0.70	10.0	44	42
LG C-3, R-2, 5-10r, 10-15d	1.04	15.0	17	35
LG C-3, R-2, 5-10r, 15-20d	0.94	20.0	23	28

Appendix I

Spearman rank correlation tables for exchangeable Ca compared against depth and organized by creosote bush. Exchangeable Ca values are reported in mmol Ca/ g soil. Spearman's rho (ρ) values are as follows: Eldorado Valley creosote bush 1, ρ = -0.032, Eldorado Valley creosote bush 2, ρ = -0.050, Eldorado Valley creosote bush 3, ρ = -0.415, Lucy Gray creosote bush 1, ρ = 0.069, Lucy Gray creosote bush 2, ρ = -0.729, Lucy Gray creosote bush 3, ρ = -0.357. A positive Spearman's rho indicates a positive correlation between the two variables, while a negative Spearman's rho indicates a negative correlation. If Spearman's rho is equal to 0, then no correlation exists between the variables. A Spearman's rho of 1 or -1 indicates a perfect monotonic correlation.

Sample ID	**Exchangeable Ca (mmol Ca/g soil)**	**Max Depth**	**Rank of Exchangeable Ca**	**Rank of Depth**
EV C-1 C 0-5	0.018	5.0	25	36.5
EV C-1 C 5-10	0.018	10.0	28	30.5
EV C-1 C 10-15	0.016	15.0	38	25.5
EV C-1 C 15-20	0.015	20.0	39	21
EV C-1 C 20-25	0.020	25.0	10	17.5
EV C-1 C 25-30	0.019	30.0	16	15
EV C-1 C 30-35	0.018	35.0	26	13
EV C-1 C 35-40	0.019	40.0	19	11
EV C-1 C 40-45	0.032	45.0	2	9
EV C-1 C 45-50	0.022	50.0	6	7
EV C-1 C 50-55	0.020	55.0	12	4.5
EV C-1 C 55-60	0.017	60.0	36	2
EV C-1 I 0-5	0.018	5.0	29	36.5
EV C-1 I 5-10	0.017	10.0	33	30.5
EV C-1 I 15-20	0.018	20.0	30	21
EV C-1 I 25-30	0.019	30.0	20	15
EV C-1 I 35-40	0.019	40.0	14	11
EV C-1 I 45-50	0.020	50.0	11	7
EV C-1 I 55-60	0.022	60.0	5	2
EV C-1 F 0-5	0.038	5.0	1	36.5
EV C-1 F 5-10	0.017	10.0	32	30.5
EV C-1 F 10-15	0.018	15.0	27	25.5
EV C-1 F 15-20	0.017	20.0	31	21
EV C-1 F 20-25	0.018	25.0	24	17.5
EV C-1 F 25-30	0.018	30.0	21	15

EV C-1 F 35-40	0.021	40.0	9	11
EV C-1 F 45-50	0.017	50.0	34	7
EV C-1 F 50-55	0.018	55.0	22	4.5
EV C-1 F 55-60	0.017	60.0	35	2
EV C-1, R-1, 0-5r, 0-5d	0.021	5.0	7	36.5
EV C-1, R-1, 0-5r, 5-10d	0.019	10.0	15	30.5
EV C-1, R-1, 0-5r, 10-15d	0.019	15.0	17	25.5
EV C-1, R-1, 0-5r, 15-20d	0.016	20.0	37	21
EV C-1, R-1, 5-10r, 0-5d	0.019	5.0	13	36.5
EV C-1, R-1, 5-10r, 5-10d	0.018	10.0	23	30.5
EV C-1, R-2, 0-5r, 0-5d	0.028	5.0	3	36.5
EV C-1, R-2, 0-5r, 5-10d	0.025	10.0	4	30.5
EV C-1, R-2, 0-5r,10-15d	0.021	15.0	8	25.5
EV C-1, R-2, 0-5r, 15-20d	0.019	20.0	18	21

Sample ID	**Exchangeable Ca (mmol Ca/g soil)**	**Max Depth**	**Rank of Exchangeable Ca**	**Rank of Depth**
EV C-2 C 0-5	0.017	5.0	9	18.5
EV C-2 C 10-15	0.016	15.0	12	12.5
EV C-2 C 20-25	0.022	25.0	3	7.5
EV C-2 C 30-35	0.123	35.0	1	5.5
EV C-2 C 40-45	0.023	45.0	2	3.5
EV C-2 C 50-55	0.021	55.0	4	1.5
EV C-2 F 0-5	0.017	5.0	8	18.5
EV C-2 F 10-15	0.016	15.0	10	12.5
EV C-2 F 20-25	0.016	25.0	13	7.5
EV C-2 F 30-35	0.016	35.0	15	5.5
EV C-2 F 40-45	0.016	45.0	14	3.5
EV C-2 F 50-55	0.014	55.0	20	1.5
EV C-2, R-1, 0-5r, 0-5d	0.017	5.0	7	18.5
EV C-2, R-1, 0-5r, 5-10d	0.017	10.0	6	15.5
EV C-2, R-1, 0-5r, 10-15d	0.015	15.0	17	12.5
EV C-2, R-1, 0-5r, 15-20d	0.015	20.0	18	9.5
EV C-2, R-2, 0-5r, 0-5d	0.018	5.0	5	18.5
EV C-2, R-2, 0-5r, 5-10d	0.015	10.0	19	15.5
EV C-2, R-2, 0-5r, 10-15d	0.016	15.0	11	12.5
EV C-2, R-2, 0-5r, 15-20d	0.015	20.0	16	9.5

Sample ID	Exchangeable Ca (mmol Ca/g soil)	Max Depth	Rank of Exchangeable Ca	Rank of Depth
EV C-3 C 0-5	0.021	5.0	5	18.5
EV C-3 C 10-15	0.015	15.0	19	12.5
EV C-3 C 20-25	0.018	25.0	11	7.5
EV C-3 C 30-35	0.019	35.0	9	5.5
EV C-3 C 40-45	0.017	45.0	12	3.5
EV C-3 C 50-55	0.016	55.0	16	1.5
EV C-3 F 0-5	0.016	5.0	17	18.5
EV C-3 F 10-15	0.020	15.0	7	12.5
EV C-3 F 20-25	0.018	25.0	10	7.5
EV C-3 F 30-35	0.017	35.0	15	5.5
EV C-3 F 40-45	0.016	45.0	18	3.5
EV C-3 F 50-55	0.015	55.0	20	1.5
EV C-3, R-1, 0-5r, 0-5d	0.026	5.0	2	18.5
EV C-3, R-1, 0-5r, 5-10d	0.021	10.0	4	15.5
EV C-3, R-1, 0-5r, 10-15d	0.021	15.0	6	12.5
EV C-3, R-1, 0-5r, 15-20d	0.021	20.0	3	9.5
EV C-3, R-2, 0-5r, 0-5d	0.017	5.0	13	18.5
EV C-3, R-2, 0-5r, 5-10d	0.019	10.0	8	15.5
EV C-3, R-2, 0-5r, 10-15d	0.017	15.0	14	12.5
EV C-3, R-2, 0-5r, 15-20d	0.032	20.0	1	9.5

Sample ID	Exchangeable Ca (mmol Ca/g soil)	Max Depth	Rank of Exchangeable Ca	Rank of Depth
LG C-1 C 0-5	0.025	5.0	27	26.5
LG C-1 C 10-15	0.027	15.0	21	15.5
LG C-1 C 20-25	0.029	25.0	16	6
LG C-1 C 30-35	0.026	35.0	24	2
LG C-1 I 0-5	0.026	5.0	25	26.5
LG C-1 I 10-15	0.031	15.0	7	15.5
LG C-1 I 20-25	0.029	25.0	14	6
LG C-1 I 30-35	0.030	35.0	10	2
LG C-1 F 0-5	0.023	5.0	29	26.5
LG C-1 F 10-15	0.025	15.0	28	15.5
LG C-1 F 20-25	0.029	25.0	15	6
LG C-1 F 30-35	0.027	35.0	22	2
LG C-1 R-1, 0-5r, 0-5d	0.029	5.0	13	26.5
LG C-1 R-1, 0-5r, 5-8d	0.030	8.0	12	23

LG C-1 R-1 0-5r, 8-12d	0.026	12.0	26	20
LG C-1 R-1, 0-5r, 12-15d	0.031	15.0	8	15.5
LG C-1 R-1, 0-5r, 15-20d	0.032	20.0	4	10
LG C-1 R-2, 0-5r, 7.5-12.5d	0.033	12.5	1	19
LG C-1 R-2, 0-5r, 12.5-17.5d	0.028	17.5	17	12
LG C-1 R-2, 0-5r, 17.5-22.5d	0.028	22.5	20	8
LG C-1 R-2, 0-5r, 22.5-27.5d	0.033	27.5	2	4
LG C-1 R-3, 0-5r, 0-5d	0.032	5.0	5	26.5
LG C-1 R-3, 0-5r, 5-10d	0.030	10.0	9	21.5
LG C-1 R-3, 0-5r, 10-15d	0.032	15.0	6	15.5
LG C-1 R-3, 0-5r, 15-20d	0.030	20.0	11	10
LG C-1 R-3, 5-10r, 0-5d	0.033	5.0	3	26.5
LG C-1 R-3, 5-10r, 5-10d	0.026	10.0	23	21.5
LG C-1 R-3, 5-10r, 10-15d	0.028	15.0	18	15.5
LG C-1 R-3, 5-10r, 15-20d	0.028	20.0	19	10

Sample ID	**Exchangeable Ca (mmol Ca/g soil)**	**Max Depth**	**Rank of Exchangeable Ca**	**Rank of Depth**
LG C-2 C 0-5	0.020	5.0	6	18.5
LG C-2 C 10-15	0.018	15.0	14	12.5
LG C-2 C 20-25	0.017	25.0	17	7.5
LG C-2 C 30-35	0.018	35.0	13	5.5
LG C-2 C 40-45	0.020	45.0	5	3.5
LG C-2 C 50-55	0.017	55.0	16	1.5
LG C-2 F 0-5	0.028	5.0	1	18.5
LG C-2 F 10-15	0.020	15.0	7	12.5
LG C-2 F 20-25	0.014	25.0	20	7.5
LG C-2 F 30-35	0.014	35.0	19	5.5
LG C-2 F 40-45	0.015	45.0	18	3.5
LG C-2 F 50-55	0.018	55.0	15	1.5
LG C-2, R-1, 0-5r, 0-5d	0.022	5.0	4	18.5
LG C-2, R-1, 0-5r, 5-10d	0.019	10.0	9	15.5
LG C-2, R-1, 0-5r, 10-15d	0.018	15.0	12	12.5
LG C-2, R-1, 0-5r, 15-20d	0.018	20.0	11	9.5
LG C-2, R-2, 0-5r, 0-5d	0.024	5.0	2	18.5
LG C-2, R-2, 0-5r, 5-10d	0.024	10.0	3	15.5
LG C-2, R-2, 0-5r, 10-15d	0.019	15.0	10	12.5
LG C-2, R-2, 0-5r, 15-20d	0.019	20.0	8	9.5

Sample ID	Exchangeable Ca (mmol Ca/g soil)	Max Depth	Rank of Exchangeable Ca	Rank of Depth
LG C-3 C 0-5	0.033	5.0	2	18.5
LG C-3 C 10-15	0.031	15.0	4	12.5
LG C-3 C 20-25	0.030	25.0	5	7.5
LG C-3 C 30-35	0.028	35.0	9	5.5
LG C-3 C 40-45	0.028	45.0	8	3.5
LG C-3 C 50-55	0.026	55.0	17	1.5
LG C-3 F 0-5	0.028	5.0	12	18.5
LG C-3 F 10-15	0.028	15.0	13	12.5
LG C-3 F 20-25	0.029	25.0	6	7.5
LG C-3 F 30-35	0.024	35.0	18	5.5
LG C-3 F 40-45	0.028	45.0	10	3.5
LG C-3 F 50-55	0.024	55.0	19	1.5
LG C-3, R-1, 0-5r, 0-5d	0.034	5.0	1	18.5
LG C-3, R-1, 0-5r, 5-10d	0.027	10.0	15	15.5
LG C-3, R-1, 0-5r, 10-15d	0.029	15.0	7	12.5
LG C-3, R-1, 0-5r, 15-20d	0.028	20.0	11	9.5
LG C-3, R-2, 0-5r, 0-5d	0.027	5.0	16	18.5
LG C-3, R-2, 0-5r, 5-10d	0.032	10.0	3	15.5
LG C-3, R-2, 0-5r, 10-15d	0.028	15.0	14	12.5
LG C-3, R-2, 0-5r, 15-20d	0.023	20.0	20	9.5

Appendix J

Spearman rank correlation tables for $CaCO_3$ compared against depth and organized by creosote bush. $CaCO_3$ values are reported in weight % $CaCO_3$. Spearman's rho (ρ) values are as follows: Eldorado Valley creosote bush 1, $\rho = 0.737$, Eldorado Valley creosote bush 2, $\rho = 0.301$, Eldorado Valley creosote bush 3, $\rho = 0.680$, Lucy Gray creosote bush 1, $\rho = 0.750$, Lucy Gray creosote bush 2, $\rho = -0.383$, Lucy Gray creosote bush 3, $\rho = 0.785$. A positive Spearman's rho indicates a positive correlation between the two variables, while a negative Spearman's rho indicates a negative correlation. If Spearman's rho is equal to 0, then no correlation exists between the variables. A Spearman's rho of 1 or -1 indicates a perfect monotonic correlation.

Sample ID	**$CaCO_3$ (weight %)**	**Max Depth**	**Rank of $CaCO_3$**	**Rank of Depth**
EV C-1 C 0-5	0.0042	5.0	29	36.5
EV C-1 C 5-10	0.0034	10.0	32	30.5
EV C-1 C 10-15	0.0060	15.0	17	25.5
EV C-1 C 15-20	0.0053	20.0	22	21
EV C-1 C 20-25	0.0042	25.0	27	17.5
EV C-1 C 25-30	0.0062	30.0	16	15
EV C-1 C 30-35	0.0183	35.0	3	13
EV C-1 C 35-40	0.0054	40.0	21	11
EV C-1 C 40-45	0.0185	45.0	2	9
EV C-1 C 45-50	0.0078	50.0	11	7
EV C-1 C 50-55	0.0067	55.0	14	4.5
EV C-1 C 55-60	0.0093	60.0	7	2
EV C-1 I 0-5	0.0029	5.0	37	36.5
EV C-1 I 5-10	0.0058	10.0	19	30.5
EV C-1 I 15-20	0.0058	20.0	18	21
EV C-1 I 25-30	0.0045	30.0	24	15
EV C-1 I 35-40	0.0093	40.0	8	11
EV C-1 I 45-50	0.0186	50.0	1	7
EV C-1 I 55-60	0.0166	60.0	4	2
EV C-1 F 0-5	0.0160	5.0	5	36.5
EV C-1 F 5-10	0.0030	10.0	36	30.5
EV C-1 F 10-15	0.0043	15.0	25	25.5
EV C-1 F 15-20	0.0054	20.0	20	21
EV C-1 F 20-25	0.0063	25.0	15	17.5
EV C-1 F 25-30	0.0121	30.0	6	15
EV C-1 F 35-40	0.0083	40.0	9	11

EV C-1 F 45-50	0.0072	50.0	12	7
EV C-1 F 50-55	0.0067	55.0	13	4.5
EV C-1 F 55-60	0.0081	60.0	10	2
EV C-1, R-1, 0-5r, 0-5d	0.0030	5.0	34	36.5
EV C-1, R-1, 0-5r, 5-10d	0.0020	10.0	39	30.5
EV C-1, R-1, 0-5r, 10-15d	0.0036	15.0	30	25.5
EV C-1, R-1, 0-5r, 15-20d	0.0043	20.0	26	21
EV C-1, R-1, 5-10r, 0-5d	0.0042	5.0	28	36.5
EV C-1, R-1, 5-10r, 5-10d	0.0046	10.0	23	30.5
EV C-1, R-2, 0-5r, 0-5d	0.0027	5.0	38	36.5
EV C-1, R-2, 0-5r, 5-10d	0.0030	10.0	35	30.5
EV C-1, R-2, 0-5r,10-15d	0.0030	15.0	33	25.5
EV C-1, R-2, 0-5r, 15-20d	0.0035	20.0	31	21

Sample ID	$CaCO_3$ (weight %)	Max Depth	Rank of $CaCO_3$	Rank of Depth
EV C-2 C 0-5	0.0041	5.0	17	18.5
EV C-2 C 10-15	0.0056	15.0	9	12.5
EV C-2 C 20-25	0.0132	25.0	2	7.5
EV C-2 C 30-35	0.0154	35.0	1	5.5
EV C-2 C 40-45	0.0072	45.0	5	3.5
EV C-2 C 50-55	0.0067	55.0	7	1.5
EV C-2 F 0-5	0.0055	5.0	10	18.5
EV C-2 F 10-15	0.0041	15.0	16	12.5
EV C-2 F 20-25	0.0067	25.0	8	7.5
EV C-2 F 30-35	0.0052	35.0	12	5.5
EV C-2 F 40-45	0.0050	45.0	13	3.5
EV C-2 F 50-55	0.0049	55.0	14	1.5
EV C-2, R-1, 0-5r, 0-5d	0.0079	5.0	4	18.5
EV C-2, R-1, 0-5r, 5-10d	0.0020	10.0	20	15.5
EV C-2, R-1, 0-5r, 10-15d	0.0027	15.0	19	12.5
EV C-2, R-1, 0-5r, 15-20d	0.0046	20.0	15	9.5
EV C-2, R-2, 0-5r, 0-5d	0.0052	5.0	11	18.5
EV C-2, R-2, 0-5r, 5-10d	0.0028	10.0	18	15.5
EV C-2, R-2, 0-5r, 10-15d	0.0070	15.0	6	12.5
EV C-2, R-2, 0-5r, 15-20d	0.0087	20.0	3	9.5

Sample ID	$CaCO_3$ (weight %)	Max Depth	Rank of $CaCO_3$	Rank of Depth
EV C-3 C 0-5	0.0024	5.0	19	18.5
EV C-3 C 10-15	0.0073	15.0	8	12.5
EV C-3 C 20-25	0.0072	25.0	9	7.5
EV C-3 C 30-35	0.0078	35.0	3	5.5
EV C-3 C 40-45	0.0077	45.0	4	3.5
EV C-3 C 50-55	0.0076	55.0	5	1.5
EV C-3 F 0-5	0.0026	5.0	18	18.5
EV C-3 F 10-15	0.0044	15.0	14	12.5
EV C-3 F 20-25	0.0075	25.0	6	7.5
EV C-3 F 30-35	0.0068	35.0	10	5.5
EV C-3 F 40-45	0.0074	45.0	7	3.5
EV C-3 F 50-55	0.0063	55.0	12	1.5
EV C-3, R-1, 0-5r, 0-5d	0.0017	5.0	20	18.5
EV C-3, R-1, 0-5r, 5-10d	0.0030	10.0	17	15.5
EV C-3, R-1, 0-5r, 10-15d	0.0042	15.0	15	12.5
EV C-3, R-1, 0-5r, 15-20d	0.0047	20.0	13	9.5
EV C-3, R-2, 0-5r, 0-5d	0.0038	5.0	16	18.5
EV C-3, R-2, 0-5r, 5-10d	0.0065	10.0	11	15.5
EV C-3, R-2, 0-5r, 10-15d	0.0080	15.0	2	12.5
EV C-3, R-2, 0-5r, 15-20d	0.0106	20.0	1	9.5

Sample ID	$CaCO_3$ (weight %)	Max Depth	Rank of $CaCO_3$	Rank of Depth
LG C-1 C 0-5	0.0155	5.0	23	26.5
LG C-1 C 10-15	0.0169	15.0	20	15.5
LG C-1 C 20-25	0.0245	25.0	6	6
LG C-1 C 30-35	0.0238	35.0	8	2
LG C-1 I 0-5	0.0186	5.0	18	26.5
LG C-1 I 10-15	0.0154	15.0	24	15.5
LG C-1 I 20-25	0.0216	25.0	11	6
LG C-1 I 30-35	0.0194	35.0	16	2
LG C-1 F 0-5	0.0112	5.0	28	26.5
LG C-1 F 10-15	0.0200	15.0	14	15.5
LG C-1 F 20-25	0.0283	25.0	2	6
LG C-1 F 30-35	0.0290	35.0	1	2
LG C-1 R-1, 0-5r, 0-5d	0.0116	5.0	27	26.5
LG C-1 R-1, 0-5r, 5-8d	0.0167	8.0	21	23

LG C-1 R-1 0-5r, 8-12d	0.0152	12.0	25	20
LG C-1 R-1, 0-5r, 12-15d	0.0161	15.0	22	15.5
LG C-1 R-1, 0-5r, 15-20d	0.0202	20.0	13	10
LG C-1 R-2, 0-5r, 7.5-12.5d	0.0136	12.5	26	19
LG C-1 R-2, 0-5r, 12.5-17.5d	0.0196	17.5	15	12
LG C-1 R-2, 0-5r, 17.5-22.5d	0.0242	22.5	7	8
LG C-1 R-2, 0-5r, 22.5-27.5d	0.0246	27.5	5	4
LG C-1 R-3, 0-5r, 0-5d	0.0084	5.0	29	26.5
LG C-1 R-3, 0-5r, 5-10d	0.0193	10.0	17	21.5
LG C-1 R-3, 0-5r, 10-15d	0.0233	15.0	9	15.5
LG C-1 R-3, 0-5r, 15-20d	0.0225	20.0	10	10
LG C-1 R-3, 5-10r, 0-5d	0.0184	5.0	19	26.5
LG C-1 R-3, 5-10r, 5-10d	0.0210	10.0	12	21.5
LG C-1 R-3, 5-10r, 10-15d	0.0278	15.0	3	15.5
LG C-1 R-3, 5-10r, 15-20d	0.0252	20.0	4	10

Sample ID	**$CaCO_3$ (weight %)**	**Max Depth**	**Rank of $CaCO_3$**	**Rank of Depth**
LG C-2 C 0-5	0.0038	5.0	14	18.5
LG C-2 C 10-15	0.0109	15.0	4	12.5
LG C-2 C 20-25	0.0108	25.0	5	7.5
LG C-2 C 30-35	0.0117	35.0	3	5.5
LG C-2 C 40-45	0.0047	45.0	13	3.5
LG C-2 C 50-55	0.0032	55.0	19	1.5
LG C-2 F 0-5	0.0100	5.0	7	18.5
LG C-2 F 10-15	0.0092	15.0	9	12.5
LG C-2 F 20-25	0.0035	25.0	17	7.5
LG C-2 F 30-35	0.0035	35.0	16	5.5
LG C-2 F 40-45	0.0034	45.0	18	3.5
LG C-2 F 50-55	0.0023	55.0	20	1.5
LG C-2, R-1, 0-5r, 0-5d	0.0095	5.0	8	18.5
LG C-2, R-1, 0-5r, 5-10d	0.0132	10.0	2	15.5
LG C-2, R-1, 0-5r, 10-15d	0.0086	15.0	11	12.5
LG C-2, R-1, 0-5r, 15-20d	0.0105	20.0	6	9.5
LG C-2, R-2, 0-5r, 0-5d	0.0037	5.0	15	18.5
LG C-2, R-2, 0-5r, 5-10d	0.0089	10.0	10	15.5
LG C-2, R-2, 0-5r, 10-15d	0.0059	15.0	12	12.5
LG C-2, R-2, 0-5r, 15-20d	0.0144	20.0	1	9.5

Sample ID	$CaCO_3$ (weight %)	Max Depth	Rank of $CaCO_3$	Rank of Depth
LG C-3 C 0-5	0.0151	5.0	12	18.5
LG C-3 C 10-15	0.0180	15.0	10	12.5
LG C-3 C 20-25	0.0254	25.0	6	7.5
LG C-3 C 30-35	0.0276	35.0	3	5.5
LG C-3 C 40-45	0.0294	45.0	1	3.5
LG C-3 C 50-55	0.0268	55.0	4	1.5
LG C-3 F 0-5	0.0144	5.0	13	18.5
LG C-3 F 10-15	0.0183	15.0	9	12.5
LG C-3 F 20-25	0.0262	25.0	5	7.5
LG C-3 F 30-35	0.0191	35.0	7	5.5
LG C-3 F 40-45	0.0289	45.0	2	3.5
LG C-3 F 50-55	0.0186	55.0	8	1.5
LG C-3, R-1, 0-5r, 0-5d	0.0066	5.0	20	18.5
LG C-3, R-1, 0-5r, 5-10d	0.0109	10.0	16	15.5
LG C-3, R-1, 0-5r, 10-15d	0.0125	15.0	14	12.5
LG C-3, R-1, 0-5r, 15-20d	0.0094	20.0	19	9.5
LG C-3, R-2, 0-5r, 0-5d	0.0097	5.0	18	18.5
LG C-3, R-2, 0-5r, 5-10d	0.0120	10.0	15	15.5
LG C-3, R-2, 0-5r, 10-15d	0.0107	15.0	17	12.5
LG C-3, R-2, 0-5r, 15-20d	0.0164	20.0	11	9.5

References

Amundson, R., Stern, L., Baisden, T., and Wang, Y., 1998, The isotopic composition of soil and soil-respired CO2: Geoderma, v. 82, no. 1-3, p. 83-114

Bachman, G.O., and Machette, M.N., 1977, Calcic soils and calcretes in the southwestern United States: 77-794, 1 p.

Banfield, J.F., Moreau, J.W., Chan, C.S., Welch, S.A., and Little, B., 2001, Mineralogical biosignatures and the search for life on Mars: Astrobiology, v. 1, no. 4, p. 447-465

Belnap, J., 1996, Soil surface disturbances in cold deserts: effects on nitrogenase activity in cyanobacterial-lichen soil crusts: Biology and Fertility of Soils, v. 23, no. 4, p. 362-367

Belnap, J., and Gardner, J.S., 1993, Soil microstructure in soils of the Colorado Plateau: the role of the cyanobacterium Microcoleus vaginatus: Western North American Naturalist, v. 53, no. 1, p. 40-47

Belnap, J., and Gillette, D.A., 1998, Vulnerability of desert biological soil crusts to wind erosion: the influences of crust development, soil texture, and disturbance: Journal of Arid Environments, v. 39, no. 2, p. 133-142

Belnap, J., and Lange, O., 2001, Biological soil crusts: structure, function, and management: Heidelberg, Germany, Springer, p. 3-30

Benson, L. D., and Darrow, R. A., 1981, Trees and shrubs of the southwestern deserts: Tucson, AZ, University of Arizona Press, 416 p.

Bernaldi-Campesi, H., Hartnett, H., Anbar, A., Gordon, G., and Garcia-Pichel, F., 2009, Effect of biological soil crusts on soil elemental concentrations: implications for biogeochemistry and as traceable biosignatures of ancient life on land: Geobiology, v. 7, no. 3, p. 348-359

Blossfeld, S., Perriguey, J., Sterckeman, T., Morel, J.L., and Lösch, R., 2010, Rhizosphere pH dynamics in trace-metal-contaminated soils, monitored with planar pH optodes: Plant and Soil, v. 330, no. 1, p. 173-184

Bolin, B., 1977, Changes of land biota and their importance for the carbon cycle: Science, v. 196, p. 613-615

Borken, W., Davidson, E. A., Savage, K., and Gaudinski, J., Trumbore, S. E., 2002, Drying and wetting effects on carbon dioxide release from organic horizons: Soil Science Society of America Journal, v. 67, no. 6, p. 1888-1896

Bowker, M. A., Belnap, J., Davidson, D. W., and Phillips, S. L., 2005, Evidence for micronutrient limitation of biological soil crusts: importance to arid lands restoration: Ecological applications, v. 15, no. 6, p. 1941-1951

Brady, N. C., and Weil, R. R., 2002, The nature and properties of soils: Prentice Hall, Upper Saddle River, NJ, 960 p.

Bravin, M., Tentscher, P., Rose, J., and Hinsinger, P., 2009, Rhizosphere pH gradient controls copper availability in a strongly acidic soil: Environmental science & technology, v. 43, no. 15, p. 5686-5691

Briones, O., Montaña, C., and Ezcurra, E., 1996, Competition between three Chihuahuan desert species: evidence from plant size-distance relations and root distribution: Journal of Vegetation Science, v. 7, no. 3, p. 453-460

Brock, A.L., and Buck, B.J., 2009, Polygenetic development of the Mormon Mesa, NV petrocalcic horizons: Geomorphic and paleoenvironmental interpretations: Catena, v. 77, no. 1, p. 65-75

Buck, B.J., and Mack, G.H., 1995, Latest Cretaceous (Maastrichtian) aridity indicated by paleosols in the McRae Formation, south-central New Mexico: Cretaceous Research, v. 16, no. 5, p. 559-572

Caldwell, M. M., Dawson, T. E., and Richards, J. H., 1998, Hydraulic lift: consequences of water efflux from the roots of plants: Oecologia, v. 113, p. 151-161

Campbell, S.E., 1979, Soil stabilization by a prokaryotic desert crust: implications for Precambrian land biota: Origins of Life and Evolution of Biospheres, v. 9, no. 4, p. 335-348

Capo, R.C., and Chadwick, O.A., 1999, Sources of strontium and calcium in desert soil and calcrete: Earth and Planetary Science Letters, v. 170, p. 61-72

Cenki-Tok, B., Chabaux, F., Lemarchand, D., Schmitt, A.D., Pierret, M.C., Viville, D., Bagard, M.L., and Stille, P., 2009, The impact of water-rock interaction and vegetation on calcium isotope fractionation in soil-and stream waters of a small, forested catchment (the Strengbach case): Geochimica et Cosmochimica Acta, v. 73, no. 8, p. 2215-2228

Cerling, T.E., 1984, The stable isotopic composition of modern soil carbonate and its relationship to climate: Earth and Planetary Science Letters, v. 71, no. 2, p. 229-240

Cerling, T.E., 1991, Carbon dioxide in the atmosphere: evidence from Cenozoic and Mesozoic paleosols: American Journal of Science, v. 291, no. 4, p. 377-400

Cerling, T.E., and Hay, R.L., 1986, An isotopic study of paleosol carbonates from Olduvai Gorge: Quaternary Research, v. 25, no. 1, p. 63-78

Cerling, T., Quade, J., Wang, Y., and Bowman, J., 1989, Carbon isotopes in soils and palaeosols as ecology and palaeoecology indicators: Nature, v. 341, no. 6238, p. 138-139

Charley, J.L., and West, N.E., 1975, Plant-induced soil chemical patterns in some shrub-dominated semi-desert ecosystems of Utah: The Journal of Ecology, p. 945-963

Chew, R.M., and Whitford, W.G., 1992, A long-term positive effect of kangaroo rats (*Dipodomys spectabilis*) on creosotebushes (*Larrea tridentata*): Journal of And Environments, v. 22, no. 4, p. 375-386.

Chew, R.M., and Chew, A.E., 1965, The primary productivity of a desert-shrub (Larrea tridentata) community: Ecological Monographs, v. 35, no. 4, p. 355-375

Coppinger, K.D., Reiners, W., Burke, I., and Olson, R., 1991, Net erosion on a sagebrush steppe landscape as determined by cesium-137 distribution: Soil Science Society of America Journal, v. 55, no. 1, p. 254-258

Crawford, C.S., and Gosz, J.R., 1982, Desert ecosystems: their resources in space and time: Environmental Conservation, v. 9, no. 03, p. 181-195

Desert Research Institute (DRI), Western Regional Climate Center: wrcc.dri.edu/cgi-bin.CliMAIN.pl?NVboul (accessed March 2012).

DOE, 1996, Final environmental impact statement for the Nevada test site and off-site locations in the state of Nevada, DOE/EIS-0243. V.1, p. 4-217-224

Dong, X., Zhang, X., Bao, X., and Wang, J., 2009, Spatial distribution of soil nutrients after the establishment of sand-fixing shrubs on sand dune: Plant, Soil and Environment, v. 55, no. 7, p. 288-294

Dott Jr, R., 2003, The importance of eolian abrasion in supermature quartz sandstones and the paradox of weathering on vegetation-free landscapes: The Journal of geology, v. 111, no. 4, p. 387-405

Drever, J., and Stillings, L., 1997, The role of organic acids in mineral weathering: Colloids and Surfaces A: Physicochemical and Engineering Aspects, v. 120, no. 1-3, p. 167-181

Edwards, N., and Harris, W., 1977, Carbon cycling in a mixed deciduous forest floor: Ecology, p. 431-437

Evans, R., and Johansen, J., 1999, Microbiotic crusts and ecosystem processes: Critical Reviews in Plant Sciences, v. 18, no. 2, p. 183-225

Fisk, M., Popa, R., Mason, O., Storrie-Lombardi, M., and Vicenzi, E., 2006, Iron-magnesium silicate bioweathering on Earth (and Mars?): Astrobiology, v. 6, no. 1, p. 48-68

Fletcher, J.E., and Martin, W., 1948, Some effects of algae and molds in the rain-crust of desert soils: Ecology, v. 29, no. 1, p. 95-100

Fonteyn, P.J., and Mahall, B.E., 1978, Competition among desert perennials: Nature, v. 275, no. 5680, p. 544-545

Garcia, C., Roldan, A., and Hernandez, T., 2005, Ability of different plant species to promote microbiological processes in semiarid soil: Geoderma, v. 124, no. 1-2, p. 193-202

Gardner, L.R., 1972, Origin of the Mormon Mesa caliche, Clark County, Nevada: Geological Society of America Bulletin, v. 83, no. 1, p. 143-156

Gerakis, P., and Tsangarakis, C., 1970, The influence of Acacia senegal on the fertility of a sand sheet ('goz') soil in the central Sudan: Plant and Soil, v. 33, no. 1, p. 81-86

Gibbens, R.P., and Lenz, J.M., 2001, Root systems of some Chihuahuan Desert plants: Journal of Arid Environments, v. 49, no. 2, p. 221-263

Gile, L.H., Peterson, F.F., and Grossman, R.B., 1966, Morphological and genetic sequences of carbonate accumulation in desert soils: Soil Science, v. 101, p. 347-360

Giri, B., Kapoor, R., and Mukerji, K., 2003, Influence of arbuscular mycorrhizal fungi and salinity on growth, biomass, and mineral nutrition of Acacia auriculiformis: Biology and Fertility of Soils, v. 38, no. 3, p. 170-175

Goossens, D., and Offer, Z.Y., 1994, An evaluation of the efficiency of some eolian dust collectors: Soil Technology, v. 7, p. 25-35

Gutiérrez, J. L. and Jones, C. G., 2006, Physical ecosystem engineers as agents of biogeochemical heterogeneity: Bioscience, v. 56, no. 3, p. 227-236

Harper, K.T., and Pendleton, R.L., 1993, Cyanobacteria and cyanolichens: can they enhance availability of essential minerals for higher plants? Western North American Naturalist, v. 53, no. 1, p. 59-72

Hartle, R., Fernandez, G., and Nowak, R., 2006, Horizontal and vertical zones of influence for root systems of four Mojave Desert shrubs: Journal of Arid Environments, v. 64, no. 4, p. 586-603

Hausrath, E., Neaman, A., and Brantley, S., 2009, Elemental release rates from dissolving basalt and granite with and without organic ligands: American Journal of Science, v. 309, no. 8, p. 633

Hausrath, E. M., Navarre-Sitchler, A. K., Sak, P. B., Williams, J. Z., Brantley, S. L., 2011, Soil profiles as indicators of mineral weathering rates and organic interactions for a Pennsylvania diabase: Chemical Geology, v. 290, p. 89-100.

Haynes, B.E., and Gower, S.T., 1995, Belowground carbon allocation in unfertilized and fertilized red pine plantations in northern Wisconsin: Tree physiology, v. 15, no. 5, p. 317-325

Haynes, R., 1990, Active ion uptake and maintenance of cation-anion balance: A critical examination of their role in regulating rhizosphere pH: Plant and Soil, v. 126, no. 2, p. 247-264

Hembree, D.I., and Hasiotis, S.T., 2008, Miocene vertebrate and invertebrate burrows defining compound paleosols in the Pawnee Creek Formation, Colorado, USA: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 270, no. 3-4, p. 349-365

Hinsinger, P., Plassard, C., Tang, C., and Jaillard, B., 2003, Origins of root-mediated pH changes in the rhizosphere and their responses to environmental constraints: a review: Plant and Soil, v. 248, no. 1, p. 43-59

Hoffland, E., Findenegg, G.R., and Nelemans, J.A., 1989, Solubilization of rock phosphate by rape: Plant and Soil, v. 113, no. 2, p. 155-160

Holmden, C., and Bélanger, N., 2010, Ca isotope cycling in a forested ecosystem: Geochimica et Cosmochimica Acta, v. 74, no. 3, p. 995-1015

House, K. P., Buck, B.J., and Ramelli, A.R., 2010, Geologic assessment of piedmont and playa flood hazards in the Ivanpah Valley Area, Clark County, Nevada: 53, 50,000 p.

House, K. P., Ramelli, A. R., Buck, B. J., 2006, Surficial geologic map of the Ivanpah Valley area, Clark County, Nevada: Nevada Bureau of Mines and Geology, Scale: 1:50,000, 1 sheet.

Jacobs, D.F., and Timmer, V.R., 2005, Fertilizer-induced changes in rhizosphere electrical conductivity: relation to forest tree seedling root system growth and function: New Forests, v. 30, no. 2, p. 147-166

Jacobson, A. D., Blum, J. D., Chamberlain, C. P., Poage, M. A., Sloan, V. F., 2002, Ca/Sr and Sr isotope systematic of a Himalayan glacial chronosequence: carbonate vs. silicate weathering rates as a function of landscape age: Geochimica et Cosmochimica Acta, v. 66, no. 1, p. 13-27

Jacobson, A.D., and Holmden, C. , 2006, Calcite dust and the atmospheric supply of Nd to the Japan Sea: Earth and Planetary Science Letters, v. 244, no. 1,2, p. 418-430

Jenny, H., 1941, Factors of soil formation, McGraw-Hill Book Co

Jiamao, H., Keppens, E., Tungsheng, L., Paepe, R., Wenying, J., 1997, Stable isotope composition of the carbonate concretion in loess and climate change: Quaternary International, v. 37, p. 37-43

Jones, D.L., 1998, Organic acids in the rhizosphere–a critical review: Plant and Soil, v. 205, no. 1, p. 25-44

Jones, D.L., and Darrah, P.R., 1994, Role of root derived organic acids in the mobilization of nutrients from the rhizosphere: Plant and Soil, v. 166, no. 2, p. 247-257

Kirkby, E. A. and Pilbeam, D. J., 1984, Calcium as a plant nutrient: Plant, Cell, and Environment, v. 7, p. 397-405.

Koehler, P.A., Anderson, R.S., and Spaulding, W.G., 2005, Development of vegetation in the central Mojave Desert of California during the late Quaternary: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 215, no. 3-4, p. 297-311

Kraus, M.J., 1999, Paleosols in clastic sedimentary rocks: their geologic applications: Earth-Science Reviews, v. 47, no. 1-2, p. 41-70

Li, C., Li, Y., and Ma, J., 2011, Spatial heterogeneity of soil chemical properties at fine scales induced by Haloxylon ammodendron (Chenopodiaceae) plants in a sandy desert: Ecological Research, v. 26, no. 2, p. 385-394

Loneragan, J., and Snowball, K., 1969, Calcium requirements of plants: Aust.J.Agric.Res, v. 20, no. 465-478, p. 442

Longwell, C. R., Pampeyan, E. H., Bowyer, B., 1964, Geologic map of Clark County, Nevada: Nevada Bureau of Mines and Geology, scale 1:250,000, 1 sheet.

Longwell, C. R., Pampeyan, E. H., Bowyer, B., Roberts, R. J., 1965, Geology and mineral deposits of Clark County, Nevada: Reno, NV, Nevada Bureau of Mines and Geology, 218 p.

Ludwig, J.A., Reynolds, J.F., and Whitson, P.D., 1975, Size-biomass relationships of several Chihuahuan desert shrubs: American Midland Naturalist, p. 451-461

Marion, G.M., Schlesinger, W., and Fonteyn, P., 1985, CALDEP: A regional model for soil CaCO3 (caliche) deposition in southwestern deserts: Soil Science, v. 139, no. 5, p. 468

Mayer, L., McFadden, L.D., and Harden, J.W., 1988, Distribution of calcium carbonate in desert soils: A model: Geology, v. 16, p. 303-306

Mayland, H., and McIntosh, T., 1966, Availability of biologically fixed atmospheric nitrogen-15 to higher plants:

Navar, J., and Bryan, R., 1990, Interception loss and rainfall redistribution by three semi-arid growing shrubs in northeastern Mexico: Journal of Hydrology, v. 115, no. 1-4, p. 51-63

Nettleton, W., Olson, C., and Wysocki, D., 2000, Paleosol classification: problems and solutions: Catena, v. 41, no. 1-3, p. 61-92

Nezat, C.A., Blum, J.D., Yanai, R.D., and Hamburg, S.P., 2007, A sequential extraction to determine the distribution of apatite in granitoid soil mineral pools with application to weathering at the Hubbard Brook Experimental Forest, NH, USA: Applied Geochemistry, v. 22, p. 2406-2421

Nie, W., 2009, Effects of plant uptake and micro-topography on chloride transport in arid soils [M.S. thesis]: Las Vegas, University of Nevada, Las Vegas, 125 p.

Nie, W., Nicholl, M. J., Young, M. H., Yu, Z., 2012, Impact of Larrea tridentata on chloride distribution in the vadose zone: Manuscript in preparation.

Nye, P., 1981, Changes of pH across the rhizosphere induced by roots: Plant and Soil, v. 61, no. 1, p. 7-26

Ohmoto, H., 1996, Evidence in pre–2.2 Ga paleosols for the early evolution of atmospheric oxygen and terrestrial biota: Geology, v. 24, no. 12, p. 1135

Page, B.D., Bullen, T.D., and Mitchell, M.J., 2008, Influences of calcium availability and tree species on Ca isotope fractionation in soil and vegetation: Biogeochemistry, v. 88, no. 1, p. 1-13

Parsons, A.J., Abrahams, A.D., and Simanton, J.R., 1992, Microtopography and soil-surface materials on semi-arid piedmont tiülslopes, southern Arizona: Journal of And Environments, v. 22, p. 107-115

Perakis, S.S., Maguire, D.A., Bullen, T.D., Cromack, K., Waring, R.H., and Boyle, J.R., 2006, Coupled nitrogen and calcium cycles in forests of the Oregon Coast Range: Ecosystems, v. 9, no. 1, p. 63-74

Prasad, N., and Roscoe, S., 1996, Evidence of anoxic to oxic atmospheric change during 2.45-2.22 Ga from lower and upper sub-Huronian paleosols, Canada1: Catena, v. 27, no. 2, p. 105-121

Prospero, J.M., Ginoux, P., Torres, O., Nicholson, S.E., and Gill, T.E., 2002, Environmental characterization of global sources of atmospheric soil dust identified with the Nimbus 7 Total Ozone Mapping Spectrometer (TOMS) absorbing aerosol product: Rev.Geophys, v. 40, no. 1, p. 1002

Rech, J. A., Currie, B. S., Michalski, G., Cowan, A. M., 2006, Neogene climate change and uplift in the Atacama Desert, Chile: Geology, v. 34, no. 9, p. 761-764.

Reheis, M.C., Goodmacher, J.C., Harden, J.W., McFadden, L.D., Rockwell, T.K., Shroba, R.R., Sowers, J.M., and Taylor, E.M., 1995, Quaternary soils and dust deposition in southern Nevada and California: Geological Society of America Bulletin, v. 107, p. 1003-1022

Reheis, M.C., and Kihl, R., 1995, Dust deposition in southern Nevada and California, 1984-1989: Relations to climate, source area, and source lithology: Journal of Geophysical Research.D.Atmospheres, v. 100, p. 8893-8918

Reheis, M.C., Sowers, J.M., Taylor, E.M., McFadden, L.D., and Harden, J.W., 1992, Morphology and genesis of carbonate soils on the Kyle Canyon fan, Nevada, USA: Geoderma, v. 52, p. 303-342

Retallack, G.J., 2005, Pedogenic carbonate proxies for amount and seasonality of precipitation in paleosols: Geology, v. 33, no. 4, p. 333-336

Reynolds, R.L., Yount, J.C., Reheis, M., Goldstein, H., Chavez Jr, P., Fulton, R., Whitney, J., Fuller, C., and Forester, R.M., 2007, Dust emission from wet and dry playas in the Mojave Desert, USA: Earth Surface Processes and Landforms, v. 32, p. 1811-1827

Reynolds, R.L., Bogle, R., Vogel, J., Goldstein, H., and Yount, J., 2009, Dust emission at Franklin Lake Playa, Mojave Desert (USA): Response to meteorological and hydrologic changes 2005-2008: Natural Resources and Environmental Issues, v. 15, no. 1, p. 18

Ridolfi, L., Laio, F., and D'Odorico, P., 2008, Fertility island formation and evolution in dryland ecosystems: Ecology and Society, v. 13, no. 1, p. 5

Romney, E. M., Wallace, A., Kaaz, H., and Hale., V. Q., 1980, The role of shrubs on redistribution of mineral nutrients in the Mojave Desert: Great Basin Naturalist Memoirs, v. 4, p. 124-133

Schenk, H.J., and Jackson, R.B., 2002, Rooting depths, lateral root spreads and below-ground/above-ground allometries of plants in water-limited ecosystems: Journal of Ecology, v. 90, no. 3, p. 480-494

Schelsinger, W. H., 1984 *in* Scope 23: The role of terrestrial vegetation in the global carbon cycle: measurement by remote sensing: John Wiley and Sons Ltd, p. 111-127

Schlesinger, W.H., and Pilmanis, A.M., 1998, Plant-soil interactions in deserts: Biogeochemistry, v. 42, no. 1, p. 169-187

Schlesinger, W.H., Raikes, J.A., Hartley, A.E., and Cross, A.F., 1996, On the spatial pattern of soil nutrients in desert ecosystems: Ecology, v. 77, no. 2, p. 364-374

Sedov, S., Solleiro-Rebolledo, E., Morales-Puente, P., Arias-Herreìa, A., Vallejo-Gòmez, E., and Jasso-Castañeda, C., 2003, Mineral and organic components of the buried paleosols of the Nevado de Toluca, Central Mexico as indicators of paleoenvironments and soil evolution: Quaternary International, v. 106, p. 169-184

Shields, L.M., and Durrell, L.W., 1964, Algae in relation to soil fertility: The Botanical Review, v. 30, no. 1, p. 92-128

Singer, A., 1980, The paleoclimatic interpretation of clay minerals in soils and weathering profiles: Earth-Science Reviews, v. 15, no. 4, p. 303-326

Su, Y.Z., Zhao, H.L., Li, Y.L., and Cui, J.Y., 2004, Influencing mechanisms of several shrubs on soil chemical properties in semiarid Horqin Sandy Land, China: Arid Land Research and Management, v. 18, no. 3, p. 251-263

Titus, J. H., Nowak, R. S., Smith, S. D., 2002, Soil resource heterogeneity in the Mojave Desert: Journal of Arid Environments, v. 52, p. 269-292

Tsoar, H., and Pye, K., 1987, Dust transport and the question of desert loess formation: Sedimentology, v. 34, p. 139-153

Utsunomiya, S., Murakami, T., Nakada, M., and Kasama, T., 2003, Iron oxidation state of a 2.45-Byr-old paleosol developed on mafic volcanics: Geochimica et Cosmochimica Acta, v. 67, no. 2, p. 213-221

Vasek, F.C., 1980, Creosote bush: long-lived clones in the Mojave Desert: American Journal of Botany, p. 246-255

Wallace, A., Romney, E., and Cha, J., 1981, Depth distribution of roots of some perennial plants in the Nevada Test Site area of the northern Mojave Desert: Great Basin naturalist memoirs, no. 4, p. 201-207

Warren, S., 2001, Synopsis: influence of biological soil crusts on arid land hydrology and soil stability: Biological soil crusts: Structure, function, and management, p. 349-360

White, A. F., Bullen, T. D., Vivit, D. V., Schulz, M. S., Clow, D. W., 1999, The role of disseminated calcite in the chemical weathering of granitoid rocks: Geochimica et Cosmochimica Atca, v. 63, no. 13/14, p. 1939-1953

Williams, A. J., Buck, B. J., and Beyene, M. A., 2012, Biological soil crusts in the Mojave Desert, USA: micromorphology and pedogenesis: Soil Science Society of America Journal, v. 76, no. 5, p. 1685-1695

Weiss, N. A., 2008, Introductory Statistics: Boston, MA, Pearson Education INC, 847 p.

Young, M.H., Lyles, B.F., Healey, J., Koonce, J., Knight, E., Johnson, E., Mon, J., Berli, M., Menon, M., and Dana, G., 2009, Scaling Environmental Processes in Heterogeneous Arid Soils: Construction of Large Weighing Lysimeter Facility:

Brittany R. Myers

Education

University of Nevada, Las Vegas

M.S. Geology
GPA: 3.73
Anticipated Graduation Date: 12/2012

Albion College

B.A. Geology
GPA: 3.4
Graduation Date: 5/2010

Northville High School

Northville, MI
Graduation Date: 6/2006

Work Experience

- 2010- 2012 – UNLV Geoscience Department – Las Vegas, NV: Geology TA: Primary instructor for multiple introductory geology laboratory classes.
- 2009-2010 – Albion College Academic Skills Center – Albion, MI: Geology Tutor: ran study sessions and tutored students privately.
- 2008- 2010 – Golder Associates – Wixom, MI: Intern/ Field Technician: sampled groundwater from landfills around Michigan, data entry, and report writing.
- 2007- 2010 – Albion College Geology Department – Albion, MI: Geology Lab TA: taught Geology 101 students, checked lab reports, and tutored students

Honors and Awards

- Nevada NASA Space Grant Fellowship Recipient
- UNLV GPSA Travel Grant Recipient
- UNLV Departmental Scholarship Recipient
- Albion College Dean's List
- Albion College William-Webster Scholarship
- Albion College Departmental Honors graduate
- Sigma Xi Scientific Research Society nomination
- Member of Sigma Gamma Epsilon, Albion College

Research Experience

- 2010- 2012 – UNLV – Las Vegas, NV: Master's Research
    - Under the direction of Dr. Elisabeth (Libby) Hausrath
    - Research will culminate in Master's Thesis and publication
        - "The Impact of Creosote Bush (*Larrea tridentata*) and Biological Soil Crust on Ca Distribution in Arid Soils of the Mojave Desert"
- 2008-2010 – Albion College – Albion, MI: Student Research Assistant
    - Under the direction of Dr. Christopher Van de Ven
    - Research culminated in senior thesis
        - "Bedrock and Vegetation Influences on Aridisol Chemistry in the White Mountains, Eastern California"

Professional Organizations

- 2010 – Present – Geological Society of Nevada – Student Member
- 2008 – Present – Geological Society of America – Student Member