Mivida
Utah State Soil

Soil Science Society of America

Introduction

Many states have a designated state bird, flower, fish, tree, rock, etc. And, many states also have a state soil – one that has significance or is important to the state. The **"Mivida"** is the official state soil of Utah. Let's explore how the **Mivida** is important to Utah.

History

Mivida was designated the State Soil by the Utah Association of Professional Soil Scientists. The Utah Association of Professional Soil Scientists includes members from the Bureau of Indian Affairs, Bureau of Land Management, Forest Service, National Park Service, Natural Resources Conservation Service, and Utah State University. Mivida was established as a soil series in 1980 for the Canyonlands Area, San Juan County, Utah Soil Survey. It was chosen as the state soil because it represented the common land use of range management for livestock and wildlife and it was associated with the iconic red rock landscapes of Southeastern Utah.

What is Mivida Soil?

The Mivida soil is a deep, well-drained soil formed in *eolian* (wind-blown) sediments and local *alluvium* (deposited by water) derived dominantly from sandstone. The soils are located on structural benches and *cuestas* on the Colorado Plateau. Mivida soils are at elevations from 5,000 to 6,500 feet and slopes range from 1 to 15 percent. The annual precipitation is 9 to 13 inches with about half of this amount occurring during the growing season. This unique combination of parent material, elevation, precipitation, and landforms are extensive in Southeastern Utah and are significant factors in the formation of the Mivida soil. The Mivida soils are correlated to semi-desert ecological sites with potential vegetation of fourwing saltbush, Wyoming big sagebrush, Indian ricegrass, needle and thread, blue grama, galleta, winterfat and other native grasses, shrubs, and *forbs*. Most of the area is used for grazing of cattle or sheep or for wildlife management.

Every soil can be separated into three separate size fractions called *sand*, *silt*, and *clay*, which makes up the *soil texture*. They are present in all soils in different proportions and say a lot about the character of the soil. In Mivida soil, the topsoil or "A" horizon, is a reddish brown fine sandy loam about 7 inches thick. The fine sandy loam texture enables precipitation to infiltrate and not pond on the surface making the precipitation available to the plants. This is very important in low rainfall areas. The surface layer also includes a low accumulation of organic matter. Although organic matter is relatively low, it is also important for providing plant nutrients and soil structure in this semi-desert climate. The upper part of the subsoil is reddish yellow fine sandy loam about 15 inches thick. At depths starting at 20 to 30 inches is a calcic horizon with visible seams and veins of calcium carbonate. This calcium carbonate is leached from the upper part of the soil and precipitates at these depths. Depth to sandstone bedrock can be as shallow as 40 inches but is usually greater than 5 feet. (**Figure 1**)

Photo Soil Monolith: Chip Clark/Smithsonian Institution

Fig.1 Mivida soil profile.Credit: Smithsonian Institution.

Fig. 2 Mivida soils location. Credit: Smithsonian Institution.

Where to dig Mivida

Yes, you can dig a soil. It is called a soil pit and it shows you the *soil profile*. The different horizontal layers of the soil are called *soil horizons*. Mivida soil is moderately extensive in southeastern Utah and covers about 200,000 acres but this does not mean that other types of soil cannot be found there. (**Figure 2**) There are 980 established soil series in Utah. The large number of series is due the dramatic variation in geology, climate and elevation across the state. Mivida is mapped in the Major Land Resource Area called the Colorado Plateau. On the Colorado Plateau, elevations average about 5,000 feet and range from 3,000 to over 12,000 feet. The average annual precipitation is 6 to 18 inches but ranges to over 30 inches on the higher mountains.

Importance

What makes the **Mivida** soil so important is its use and prevalence in the State. Mivida is one of the soils commonly utilized for livestock grazing. The livestock industry includes beef, dairy and sheep with the beef industry being dominant. Livestock is a billion dollar industry in Utah. Mivida soils provide wildlife habitat for many species which include mule deer, antelope, coyotes, and numerous birds including sage grouse. A relatively small portion of the Mivida soil is used for irrigated agriculture where alfalfa hay, wheat, barley and oats are grown. It is also used for irrigated pasture.

Uses

In general, soils can be used for agriculture (growing foods, raising animals, stables); engineering (roads, buildings, tunnels); ecology (wildlife habitat, wetlands), recreation (ball fields, playground, camp areas) and more. Mivida soils are used primarily for livestock grazing (**Figure 3**) and wildlife management. In a normal year Mivida produces about 450 pounds per acre of air-dry vegetation. This isn't a high number but the large extent of soils in this precipitation zone make them an important resource for farmers, ranchers, and government land managers. Relatively small areas of the Mivida soil are used for irrigated agriculture. (**Figure 4**) Roads, building, and oil and gas exploration infrastructure are found on the Mivida soil to a very limited extent.

Limitations

When a soil cannot be used for one or more of the described functions, it is referred to as a limitation. Soil experts, called *Soil Scientists*, studied **Mivida** soil and identified that it has limitations related to annual precipitation and periodic droughts. If the vegetative cover is removed or reduced these soils are subject to wind erosion. Low organic matter and low clay content results in a low cation-exchange-capacity. A low cation-exchange-capacity provides for low natural soil fertility. For building with basements or other construction activities, the presence of hard bedrock at a depth of 40 to 60 inches or greater is a limitation.

Fig. 3 Mivida soil in rangeland. Credit: Keith Crossland, NRCS.

Fig. 4 Mivida soil in irrigated agriculture. Credit: Keith Crossland, NRCS.

Fig. 5 Utah Juniper encroachment on a Mivida soil. Credit: Kent Sutcliffe. NRCS.

Management

Mivida land use requires that land managers have a clear understanding of the ecological dynamics associated with the soil. The link between soils and ecological sites are critical for rangeland management and rangeland health in Utah. The soil surveys published for the rangelands correlate soil series and ecological sites to meet these management needs. Invasive species such as cheat grass or encroachment by native species such as Utah juniper present problems. (**Figure 5**) Cheat grass competes with native species and changes the fire regime which has a further negative impact on native species. Management of the timing for grazing and livestock numbers is an important management strategy to maintain native plant species and desirable introduced species. The success of rangeland seeding is dependent on soil moisture and soil temperature being optimum. For sage grouse, it is important to maintain a mix of sagebrush, grasses, and forbs. It is also important to avoid the encroachment of juniper trees that serve as perches for the raptors that hunt sage grouse. For irrigated agriculture, proper tillage practices are important to avoid bare soil surfaces that are vulnerable to wind erosion. Careful fertilizer management is also important because the low natural fertility of the Mivida soil. The Mivida soil is a good potential resource for irrigated agriculture because of its high available water capacity and good infiltration characteristics. However, the rare availability of an irrigation water supply is a limitation.

Mivida Formation

Before there was soil there were rocks and in between, ClORPT. Without ClORPT, there will be no soil. So, what is ClORPT? It is the five major factors that are responsible for forming a soil like the Mivida series. It stands for **Cl**imate, **O**rganisms, **R**elief, **P**arent material and **T**ime. ClORPT is responsible for the development of soil profiles and chemical properties that differentiate soils. So, the characteristics of **Mivida** (and all other soils) are determined by the influence of ClORPT. Weathering takes place when environmental processes such as rainfall, freezing and thawing act on rocks causing them to dissolve or fracture and break into pieces. ClORPT then acts on rock pieces, marine sediments and vegetative materials to form soils.

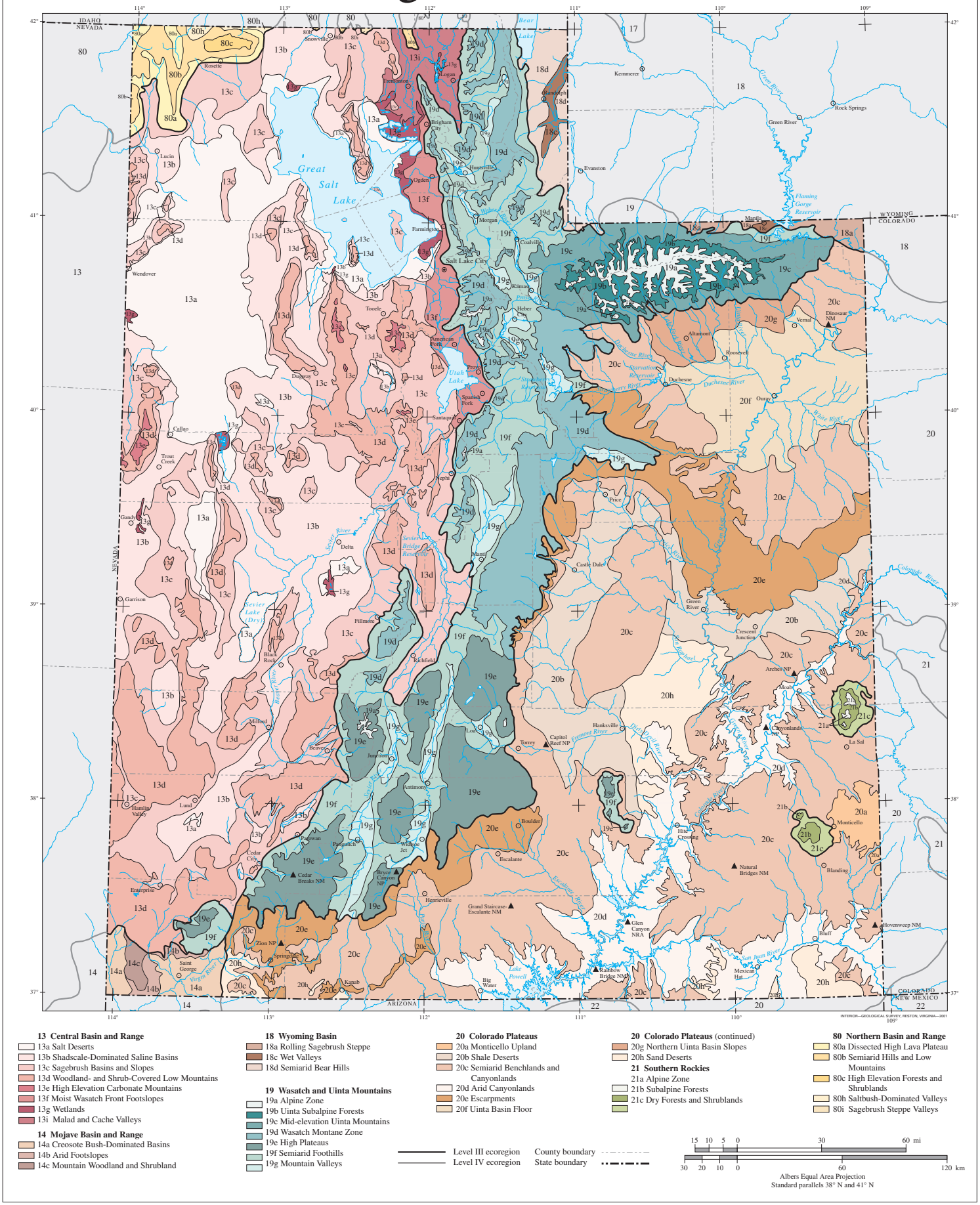
Climate – Temperature and precipitation influence the rate at which parent materials weather and dead plants and animals decompose. They affect the chemical, physical and biological relationships in the soil. Mivida soils developed in a zone of arid temperate climate characterized by periods of drought and irregular precipitation that averages 9 to 13 inches per year. The growing season is relatively warm to hot and there are long winters with sustained periods of freezing temperatures. The accumulation of carbonates at 20 to 30 inches is a result of the relatively low precipitation only leaching the carbonates to that depth.

Organisms – This refers to plants and animal life. In the soil, plant roots spread, animals burrow in, and bacteria break down plant and animal tissue. These and other soil organisms speed up the breakdown of large soil particles into smaller ones. Plants and animals also influence the formation and differentiation of soil horizons. Plants determine the kinds and amounts of *organic matter* that are added to a soil under normal conditions. Animals breakdown complex compounds into small ones and in so doing add organic matter to soil. Mivida soils developed with vegetation consisting of shrubs such as Wyoming big sagebrush and four-wing saltbush with an understory of grasses and forbs. The annual production is relatively low and there is little accumulation of organic matter. (**Figure 6**)

Relief – Landform position or relief describes the shape of the land (hills and valleys), and the direction it faces which makes a difference in how much sunlight the soil gets and how much water it keeps. Deeper soils form at the bottom of the hill rather than at the top because gravity and water move soil particles downhill. The Mivida soil formed on structural benches with level to gently rolling slopes of 1 to 15 percent. Mivida is well-drained because it is on higher positions of the landscape.

Fig. 6 Desert primrose (*mechanical pencil for scale*) and short-horned lizard, common in semi-desert environments. Credit: Meredith Albers, NRCS.

Ecoregions of Utah



13 Central Basin and Range
- 13a Salt Deserts
- 13b Shadscale-Dominated Saline Basins
- 13c Sagebrush Basins and Slopes
- 13d Woodland- and Shrub-Covered Low Mountains
- 13e High Elevation Carbonate Mountains
- 13f Moist Wasatch Front Footslopes
- 13g Wetlands
- 13i Malad and Cache Valleys

14 Mojave Basin and Range
- 14a Creosote Bush-Dominated Basins
- 14b Arid Footslopes
- 14c Mountain Woodland and Shrubland

18 Wyoming Basin
- 18a Rolling Sagebrush Steppe
- 18c Wet Valleys
- 18d Semiarid Bear Hills

19 Wasatch and Uinta Mountains
- 19a Alpine Zone
- 19b Uinta Subalpine Forests
- 19c Mid-elevation Uinta Mountains
- 19d Wasatch Montane Zone
- 19e High Plateaus
- 19f Semiarid Foothills
- 19g Mountain Valleys

20 Colorado Plateaus
- 20a Monticello Upland
- 20b Shale Deserts
- 20c Semiarid Benchlands and Canyonlands
- 20d Arid Canyonlands
- 20e Escarpments
- 20f Uinta Basin Floor

20 Colorado Plateaus (continued)
- 20g Northern Uinta Basin Slopes
- 20h Sand Deserts

21 Southern Rockies
- 21a Alpine Zone
- 21b Subalpine Forests
- 21c Dry Forests and Shrublands

80 Northern Basin and Range
- 80a Dissected High Lava Plateau
- 80b Semiarid Hills and Low Mountains
- 80c High Elevation Forests and Shrublands
- 80h Saltbush-Dominated Valleys
- 80i Sagebrush Steppe Valleys

Level III ecoregion
Level IV ecoregion
County boundary
State boundary

15 10 5 0 30 60 mi
30 20 10 0 60 120 km

Albers Equal Area Projection
Standard parallels 38° N and 41° N

Fig. 7 Ecoregions of Utah. Credit: EPA.

Parent material (C horizon) – Just like people inherit characteristics from their parents, every soil inherits some traits from the material from which it forms. Some parent materials are transported and deposited by glaciers, wind, water, or gravity. Mivida soils formed in eolian and local alluvial sediments over sandstone. Dust from regional winds are deposited on the soils and contribute to the percent of fine particles and carbonates found in the Mivida soils.

Time – All the factors act together over a very long period of time to produce soils. As a result, soils vary in age. The length of time that soil material has been exposed to the soil-forming processes makes older soils different from younger soils. Generally, older soils have better defined horizons than younger soils. Less time is needed for a soil profile to develop in a humid and warm area with dense vegetative cover than in a cold dry area with sparse plant cover. More time is required for the formation of a well-defined soil profile in soils with fine textured material than in soils with coarse-textured soil material. Mivida may have formed with changing climate and vegetation over time. For example, the late Pleistocene (126,000 ± 5,000 years ago) was apparently wetter than the current climate and may have influenced some of the soil development. During periods of drought the amount of vegetation would be diminished and the soil materials rearranged by wind and the timeframe for soil development would be reset.

Ecoregions, Soils and Land Use in Utah

In the 2001 "Ecoregions of Utah" map the Mivida soil would be in unit 20c which has the following description: "The Semiarid Benchlands and Canyonlands ecoregion is characterized by broad grass, shrub, and woodland covered benches and mesas. (**Figure 7**) Elevations mostly range from 5,000 to 7,500 feet and are higher than those of the Arid Canyonlands (20d). Low escarpments separate remnant mesa tops and narrow canyons from surrounding benches. Bedrock exposures are common along rims, escarpments, and on steep dip slopes. Soils are mostly Entisols. These deep eolian soils are composed of fine sand and support warm season grasses, winter fat, Mormon tea, four-wing saltbush, and sagebrush. Pinyon and juniper occur on shallow, stony soils. Fire suppression and erosion has allowed this woodland to expand beyond its original range. Overall, the vegetation is not as sparse as in drier areas such as Ecoregions 20b, 20d, and 20h.

Additional Resources

Soil! Get the Inside Scoop. David Lindbo and others. Soil Science Society of America, Madison, WI.

Know Soil, Know Life. David L. Lindbo, Deb A. Kozlowski, and Clay Robinson, editors. Soil Science Society of America, Madison, WI.

Web Resources

Soils for Teachers—www.soils4teachers.org

Soils for Kids—http://www.soils4kids.org/

Have Questions? Ask a Soil Scientist—https://www.soils4teachers.org/ask

Soil Science Society of America—https://www.soils.org/ /

References

2015 Utah Agriculture Statistics and Utah Department of Agriculture and Food Annual Report

Ecoregions of Utah, 2001, Woods et. al.

USDA–Agriculture Handbook 296–Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin

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Glossary

Alluvium: Pertaining to material transported and deposited by running water, including gravel, sand, clay, and various mixtures of these.

Calcic: A mineral soil horizon of secondary carbonate enrichment.

Clay: A soil particle that is less than 0.002 mm in diameter. Clay particles are so fine they have more surface area for reaction. They hold a lot of nutrients and water in the soil. A clay soil is a soil that has more than 40% clay, less than 45% sand and less than 40% silt.

Cation-exchange-capacity: A measure of the capacity of negatively charged clay and organic matter in the soil to hold cations.

Cuestas: An asymmetric ridge capped by resistant rock layers, has a long, gentle slope on one side following the bedrock and a relatively short, steep or cliff-like slope on the other that cuts through the rock layers.

Ecological sites: A distinctive kind of land with specific physical characteristics that differ from other kinds of land in its ability to produce a distinctive kind and amount of vegetation (USDA 1997).

Ecoregion: Represents areas with similar biotic and abiotic characteristics which determine the resource potential and likely responses to natural and man-made disturbances. Characteristics such as climate, topography, geology, soils, and natural vegetation define an ecoregion. They determine the type of land cover that can exist and influence the range of land use practices that are possible.

Eolian: Pertaining to material transported and deposited by the wind.

Forb: A herbaceous plant other than a grass.

Horizon: see Soil horizons

Organic matter: Material derived from the decay of plants and animals. Always contains compounds of carbon and hydrogen.

Sand: A soil particle between 0.05 and 2.0 mm in diameter. Sand is also used to describe soil texture according to the soil textural triangle, for example, loamy sand.

Silt: A soil particle between 0.002 and 0.05 mm diameter. It is also used to describe a soil textural class.

Soil Horizon: A layer of soil with properties that differ from the layers above or below it.

Soil Profile: The sequence of natural layers, or horizons, in a soil. It extends from the surface downward to unconsolidated material. Most soils have three major horizons, called the surface horizon, the subsoil, and the substratum.

Soil Scientist: A soil scientist studies the upper few meters of the Earth's crust in terms of its physical and chemical properties; distribution, genesis and morphology; and biological components. A soil scientist needs a strong background in the physical and biological sciences and mathematics.

Soil Texture: The relative proportion of sand, slit, and clay particles that make up a soil. Sand particles are the largest and clay particles the smallest. Learn more about soil texture at www.soils4teachers.org/physical-properties

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