SOILS OF UTAH

Janis L. Boettinger

The varied geology, topography, and climatic conditions in Utah have produced soils with unique characteristics and distributions. In general, soils of the mountains and benches are slightly acidic to neutral with thick, dark-colored surface horizons, while soils of the deserts are alkaline and lightly colored. Extensive areas of outcropping rock, drifting sand dunes, and playa lakebeds also characterize the state of Utah. The distributions of soils in Utah were mapped and updated by the Natural Resources Conservation Service and the National Cooperative Soil Survey in 2006. The United States General Soil Map (STATSGO2) was created by generalizing more detailed soil survey maps. Where more detailed soil survey maps were not available, data on geology, topography, vegetation, and climate were assembled, and integrated with Land Remote Sensing Satellite (LANDSAT) images, to determine soil orders and extents (NRCS, 2009b). Seven of the twelve soil orders are found in the state of Utah. Aridisols, Entisols, and Mollisols dominate, followed by Alfisols and Inceptisols (Figure 6.1). Histosols and Vertisols occur in very small tracts where parent material or moisture influences their formation.

SOIL ORDERS

Alfisols – Alfisols are moderately leached soils that have a thin and light colored surface horizon. They are characterized by an accumulation of clay in the subsoil. Although Alfisols are primarily found in temperate humid and subhumid regions of the world, some suborders of Alfisols in Utah occur on low-lake terraces and alluvial fans that have formed under the influence of a seasonal water table and sodium. Accordingly, the soil horizons are strongly alkaline and vegetation growing within them includes salt-tolerant grasses and shrubs. Other suborders of Alfisols occur in high mountains under timber, particularly conifers. These Alfisols are characterized by a thin organic layer and a thin dark surface horizon, underlain by a pale horizon from which clay has moved to the subsoil.

Aridisols – Aridisols occur where annual precipitation is less than 12 inches and the soil has experienced some development, such as subsoil accumulations of carbonates, clays, silica, salts, or gypsum. Long and dry summers contribute to the formation of this soil order. Aridisols have a light color because the arid climate typically limits plant biomass production and the accumulation of organic matter. They are moderately to very strongly alkaline, and they often have significant accumulations of calcium carbonate in the subsoil. In many locations they contain a carbonate-cemented hardpan at some depth in the soil profile.

In Utah, Aridisols are found extensively within the Great Basin, the Bear River Valley of Rich County, the Uinta Basin, the Green River Basin, the Sevier River Drainage Basin, and the Colorado Plateau. Within these regions, Aridisols occur on lower terraces, on fan slopes, and in desert valleys. Aridisols support drought resistant vegetation. Sagebrush species, saltbush species, and greasewood are the dominant vegetation types, but their presence and distribution are highly dependent on the soil depth, texture, salinity, and alkalinity. Aridisols also support Joshua tree and yucca in the lower elevations of the Mojave Desert in the southwestern corner of the state. Juniper and pinyon pine are found in the intergrade zone of Aridisols and Mollisols. Aridisols are commonly associated with Entisols and areas adjacent to and within playa, sand dune, and rock outcrop formations. Some irrigated farming occurs on Aridisols, but without irrigation they can be managed for livestock grazing, wildlife habitat, and recreation.

Entisols – Entisols are soils of recent origin that do not have discernible horizons with the exception of some darkening of the surface. They occur on younger alluvial terraces and fans, along some valley bottoms, and on stream floodplains. Entisols also occur as shallow soils on bedrock uplands in arid regions. The color of Entisols varies from light to dark, depending on the parent material. Entisols are common in the Great Basin, Colorado Plateau, and Uinta Basin, and can occupy small areas on recent floodplains in any region. Entisols are most often associated with Aridisols, Mollisols, Inceptisols, and Alfisols.

Inceptisols – Inceptisols are weakly developed soils found on relatively young geomorphic surfaces. They are more developed than Entisols, but they still lack the features that are characteristic of other soil orders. A sizeable percentage of Inceptisols are found in mountainous areas. Subsoil horizons are characterized by translocated carbonates, a brightening of the color in the subsoil, and development of subsoil structure. Inceptisols form in semiarid, sub-humid, and cool humid climates. On steep slopes in sub-humid areas, Inceptisols occupy south and west aspects. Vegetation and land use varies considerably with Inceptisols, as small areas of Inceptisols have been mapped in diverse places in Utah.

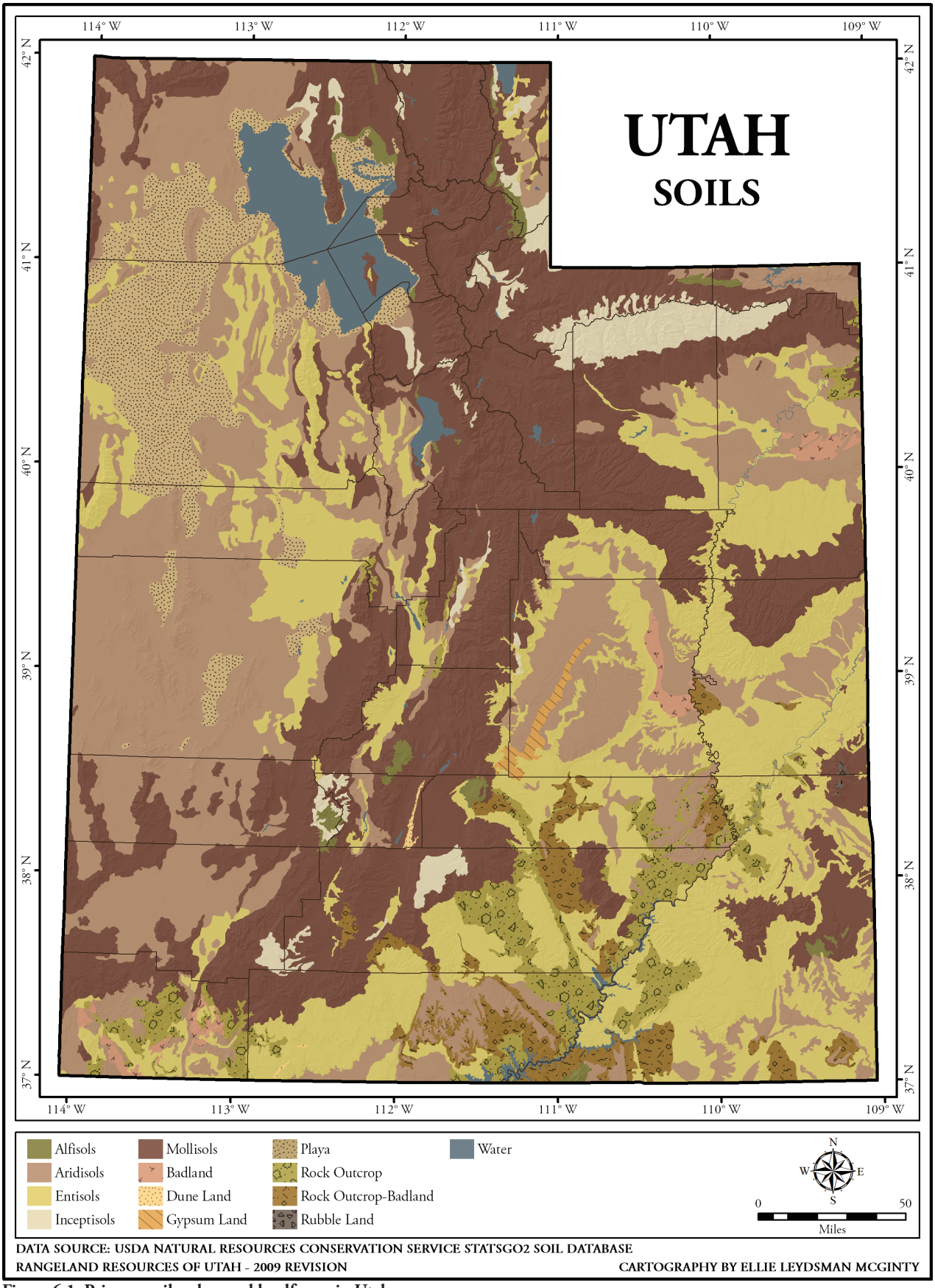

Figure 6.1. Primary soil orders and landforms in Utah.

Mollisols – Mollisols are characterized by a thick, dark, relatively fertile surface soil. They typically form under grassland vegetation, in semiarid to sub-humid shrub steppe, or in forested zones under aspen and where grasses and forbs are important components of the understory. Mollisols are rich in humus (dead and decayed plant matter contributed mainly by the fine root turnover by grasses, forbs, and shrubs). Humus stores mineral nutrients, contributes to the capacity of the soil for retaining nutrients and water, and gives the soil its dark color. The structure of the surface soil is granular with soft to slightly hard consistency. The base saturation is more than 50 percent and the soil ranges from medium acid at high elevations to moderately alkaline at the lower elevations on fans and terraces.

Mollisols are found mainly through the center of Utah from the Idaho border nearly to Arizona. They occur where average annual precipitation exceeds 12 inches and elevations are mainly above 5,000 feet. The exception is in the northern part of the state along the Wasatch Range where they occur at elevations of 4,400 to 5,000 feet. They primarily occur on lake terraces, alluvial fans, foothills, mountains, high plateaus, and valley bottoms. Mollisols are among some of the most important and productive agricultural soils. At higher elevations in Utah, they support rangeland, wildlife habitat, recreation, and timber, while at lower elevations, they support irrigated and non-irrigated cropland, rangeland, and wildlife habitat. Within the major Mollisol belt, local areas of Alfisols, Aridisols, Inceptisols, and Entisols are present.

LANDFORMS

Rock Outcrops – Rock outcrops consist of exposures of bare rock. Rock outcrops vary from the rocky summits of the Uinta Mountains and Wasatch Range to the sandstone outcrops typical of the Colorado Plateau, and from the bare surfaces along the Book and Roan Cliffs to the geologically recent lava flows on the High Plateaus. In all these areas, bare rock constitutes 50 to 75 percent of the surface, while shallow soils make up the remainder of the surface area. In Utah, national parks, national monuments, and several state parks are located in areas dominated by rock outcrops, many of which are spectacularly shaped and colored.

Dune Land – Several areas in the state have highly sandy soils and sediments, some of which are virtually devoid of vegetation. The sandy, bare surfaces are designated as dune land, and are composed of sand-sized particles that shift with the wind. Consequently, dunes typical of those found in the Sahara Desert or along ocean shores are formed. A plentiful sand source and strong prevailing winds in Juab County has created Little Sahara, one of the largest dune fields found in Utah. Most of the sand at Little Sahara National Recreation Area is the result of deposits left by the Sevier River. Coral Pink Sand Dunes in Kane County are another example of dune land in Utah.

Playas – Playas are dry or ephemeral lake beds that are typically remnants of internally drained lakes or systems. Playa sediments are fine grained and are often high in salinity. The playa areas in the Great Salt Lake Desert (Newfoundland Evaporation Basin) are characterized by intermittently wet areas, large expanses of salt pans or flats, and crystalline salt overlying stratified alkaline sediments. The Great Salt Lake Desert is the most extensive playa, but smaller playas, many of them containing salt flats, can be found elsewhere in the Lake Bonneville Basin. Playas are mostly devoid of vegetation, although some extremely salt-tolerant species, known as halophytes, may occur.

Badlands – Badlands are arid-land formations of softer sedimentary rocks and clay-rich soils that have been extensively eroded by wind and water. Badlands are typically accompanied by complex geological formations, including canyons, ravines, and gullies. The erosional processes and the geological formations tend to create irregular, jagged, fluted, and extraordinary landscapes. The term badland was first recorded by French-Canadian trappers who referred to a region of southwestern South Dakota (presently Badlands National Park) as *Les Mauvaises Terres a Traverser*, or the bad lands to cross. The term was later applied to other areas with similar eroded topography (Stevens et al., 2006). Portions of southern Utah are characterized by badland formations. Of notable interest are the Chinle Badlands formation in Grand Staircase-Escalante National Monument and the Mancos Shale badlands in Wayne County (Godfrey et al., 2008). Badlands are also commonly a source of rich fossil beds because erosion can expose the fossiliferous sedimentary layers (Stevens et al., 2006). Numerous fossiliferous badland formations exist in the United States, including those found at Dinosaur National Monument in Uintah County.