Forkwood

Wyoming State Soil

Soil Science Society of America

Introduction

Many states have designated an official state bird, flower, fish, tree, rock, etc. Similarly, each state has a state soil. A state soil is a soil that has significance or is very important to the state. Let's explore how the Forkwood soil is important to Wyoming.

History

Originally mapped as Fort Collins, the Forkwood soil was first established in 1980 in Washakie County, in the north central part of the State, to more accurately reflect the climate and *geomorphology* of Wyoming. The series was most likely named after the Fork Wood River flowing through the Shoshone National Forest. The current type location is located in Niobrara County, Wyoming.

Fig. 1. Alluvial fans are fan-shaped deposits of water-transported material (alluvium). They typically form at the base of topographic features where there is a marked break in slope. Credit: Univ. Oregon

Forkwood soils are very deep, well-drained soils formed by water washing soil particles downslope and depositing them at or near the bottom. This accumulation of soil particles is called *slope alluvium* **(Figure 1).** The parent rocks of Forkwood tend to be shales and sandstones. Originally, the land area had developed from older rock formations before the *alluvium* was deposited over them. These *deposits* become soil as they are weathered (see ClORPT below) and plants, animals and microorganisms begin to add organic matter to the top layer over thousands of years. They are found on *terraces, fans, hills, ridges* and *piedmonts* with up to 15% slope in some places, but less than 5% slope is most common. 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. The *topsoil* or A horizon (the layer of soil that we plow or plant seeds in) of the Forkwood soil is loam in its feel, has a dark grayish-brown color and could be up to 15 cm (6 inches) thick **(Figure 2)**. The *subsoil* or B horizon (the layers below the topsoil) can be clay loam that progressively becomes loam as you go deeper from the 15 cm depth down to the 76 cm (30 inches) depth in the soil. The subsoil colors can include brown, dark grayish-brown, and light olive brown color. The subsoil has a layer of clay accumulation between 13 and 51 cm (5 to 20 inches) and anywhere from 1 to 14 percent calcium carbonate starting around 30 cm (12 inches).

Fig. 2. Soil profile of a Forkwood soil. Credit: Photo: Chip Clark, Smithsonian Institute.

Fig. 3. Location of the Forkwood soil in Wyoming (and parts of Montana). Credit: Smithsonian Institution's Forces of change. http://forces.si.edu/soils/interactive/statesoils/index.html

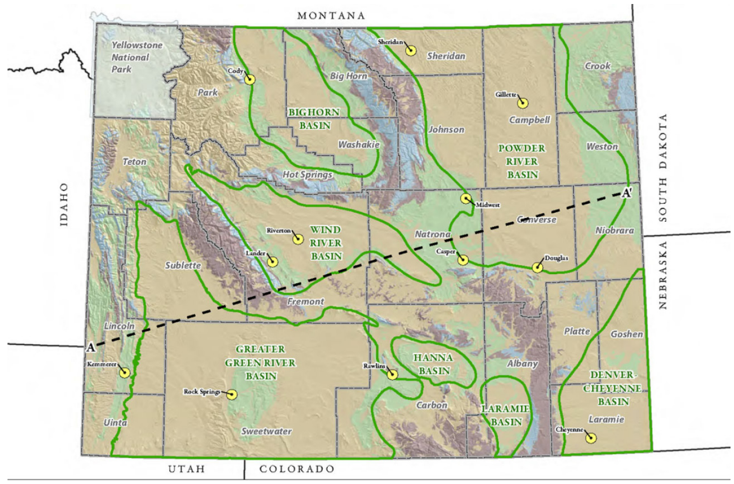

Fig. 4. Physiographic provinces of Wyoming. Credit: Wyoming State Geological Survey. http://www.wsgs.wyo.gov/Research/Geology/

Where to dig a Forkwood

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 actually called *soil horizons*. Forkwood soil covers a wide area of the State. This does not mean that other types of soil cannot be found there but that the Forkwood is the most common soil (see map in **Figure 3**).

The Forkwood series covers 506,243 acres of land in 16 counties of Wyoming and 1 county in Montana. It is found extensively in the Powder River Basin and Big Horn Basin regions of Wyoming **(Figure 4)**. In all, there are a total of 953 named soils (series) in Wyoming (see web links for more information).

Importance

What makes the Forkwood soil so important is what it is used for, and its prevalence in the State. Most of the Forkwood soils support semi-arid desert and grassland ecosystems. Common plant species consist of big sagebrush, western and bluebunch wheatgrass, bluegrass, and needleandthread. These lands are home to pronghorn antelope, mule deer, coyote, jackrabbits, cottontail rabbits, birds common to shrub steppes and much more. Much of Wyoming is rangeland. The grasses that grow on Forkwood are important for livestock grazing and wildlife habitat **(Figure 5)**.

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. The Forkwood soil supports rangeland for livestock grazing, although the Forkwood soils are also used for crop production (primarily hay). Some are also used as wildlife habitat. Additionally, some towns are located on the Forkwood soil.

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 Forkwood soils and identified that they have some limitations. While there are not many limitations, they can be prone to wind erosion. Drought is generally the greatest limitation in those areas, so irrigation may be needed in those areas where crop production is dominant. Forkwood soils can have a somewhat limiting suitability for shallow excavations due to potentially unstable excavation walls. They are also somewhat limited for onsite sewage treatment and dispersal/infiltration fields because of slow water movement.

Management

Forkwood soils are low in organic matter and have a medium natural fertility potential, but can be made more productive with through fertilization. Forkwood soils also have calcium carbonate present and, as a result, are slightly to strongly alkaline. Drought is the main limitation to the use of this soil, so irrigation is necessary to increase productivity in some locations.

Forkwood Soil Formation

Before there was soil there were rocks, and in between, ClORPT. Without ClORPT, there will be no soil. So, what is ClORPT? They are five major factors that are responsible for forming a soil like the Forkwood series. These are: **Cl**imate, **O**rganisms, **R**elief, **P**arent material and **T**ime. ClORPT is responsible for the development of soil profiles and chemical and physical properties that differentiate soils. So, the characteristics of Forkwood soils (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 now 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 of the soil. The Forkwood soils developed under a cool, arid climate with varying temperatures and limited rainfall. The influence of the two resulted in low organic matter and susceptibility to wind erosion.

Organisms – This refers to microorganisms, plants and animal life. In the soil, plant roots spread throughout, animals burrow and soil microorganisms decompose the plant and animal tissue. These microorganisms use these materials as an energy/food source. Additionally, 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 smaller ones and in so doing add organic matter to soil. Forkwood soils developed on open lands with shrubs and grasses which deposit leaves, twigs, roots and other plant remains on the surface and in the belowground soil.

Relief – Landform position or relief describes the shape of the landscape (hills and valleys), and the direction it faces (aspect) 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. Forkwood soils formed on terraces, alluvial fans and fan remnants, hills, ridges and piedmonts and are very deep and well drained.

Parent material (C horizon) – Just like people inherit characteristics from their parents, every soil inherits traits from the material from which it forms. Soil parent materials are transported and deposited by glaciers, wind, water, or gravity. Forkwood soils developed from alluvial deposits from sandstones and shales.

Time – All the factors act together over a very long 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. More time is needed for a *soil profile* to develop in a dry and cool area with limited vegetative cover where the Forkwood soil is than in a warm humid area with abundant 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.

Ecoregions, Soils and Land Use in Wyoming

The State of Wyoming has a complex geology made up of about 213 *geologic formations*. These formations lie in five regions or *physiographic provinces* **(Figure 6)**. The Forkwood soils lie within two of the provinces found in Wyoming. They are the Great Plains province and the Middle Rocky Mountains province. The soil type and characteristics depend on the type of rock from which the soil was formed.

Great Plains: The Powder River Basin is a physiographic province located in the Great Plains *ecoregion* and is one of the two provinces where the Forkwood soils are found. It has a gently to moderately sloping topography along with some badland topography. Many of the soils are characterized by alluvial deposits derived from interbedded sandstones and shales overlying older formations. The sandstones and shales are sources for clay which, in turn, influence soil textures found in the Forkwood soils. Underlying the alluvial deposits are coal beds, which play a significant role in Wyoming's economy. Additionally, there are oil and natural gas deposits which augment the coal resources. The soils tend to be moderately productive and are used extensively for grazing and wildlife habitat. There is also some production agriculture with the primary crop being hay.

Fig. 5. Forkwood soil series on gentle slopes of 0 to 2 percent is used for rangeland in Park County. Photo: Marji Patz, USDA-NRCS

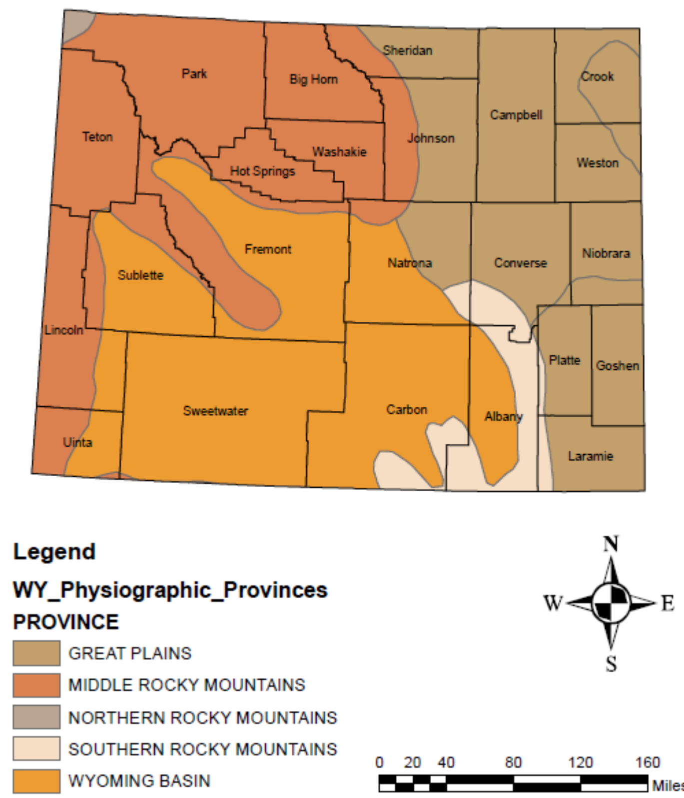

Fig. 6. The five physiographic provinces of Wyoming. The Forkwood soils are found in the Great Plains and Middle Rocky Mountains provinces. Source: water.usgs.gov/lookup/getspatial?physio

Middle Rocky Mountains: This is the second of the two ecoregions where Forkwood soils are found. The Big Horn Basin is the physiographic region within the Middle Rocky Mountains where these soils exist. It is characterized by gently to moderately sloping landscapes with some badland *topography*. In some areas, gravels have washed down from the nearby mountains and can be found in the soils. The soils here are moderately productive and are used extensively for grazing and wildlife habitat. There is also some production agriculture with the primary crop being hay.

Glossary

Alluvium: Unconsolidated, clastic material subaerially deposited by running water, including gravel, sand, silt, clay, and various mixtures of these.

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 more than 60% silt.

Deposit: Either consolidated or unconsolidated material of any type that has accumulated by natural processes or by human activity.

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.

Fan: [geomorphology] (a) A gently sloping, fan-shaped mass of detritus forming a section of a low-angle cone commonly at a place where there is a notable decrease in gradient.

Geologic formation: Is a body of rock of considerable extent with distinctive characteristics that allow geologists to map, describe, and name it.

Geomorphology: A branch of geology and geography that studies the development of landforms.

Hill: A generic term for an elevated area of the land surface, rising at least 30 m (100 ft.) to as much as 300 meters (approx. 1000 ft.) above surrounding lowlands.

Horizon: see Soil horizons

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

Physiographic province: Are broad-scale subdivisions based on terrain texture, rock type, and geologic structure and history.

Piedmont: (adjective) Lying or formed at the base of a mountain or mountain range.

Ridge: A long, narrow elevation of the land surface, usually sharp crested with steep sides and forming an extended upland between valleys. The term is used in areas of both hill and mountain relief.

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.

Slope alluvium: Sediment gradually transported down mountain or hill slopes primarily by non-channel alluvial processes (i.e., slope wash processes) and characterized by particle sorting. Lateral particle sorting is evident on long slopes. In a profile sequence, sediments may be distinguished by differences in size and/or specific gravity of rock fragments and may be separated by stone lines. Sorting of rounded or subrounded pebbles or cobbles and burnished peds distinguish these materials from unsorted colluvial deposits.

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

Soil Management: The sum total of how we prepare and nurture soil, select type of crops that suitable for a type of soil, tend the crop and the soil together, type of fertilizer and other materials added to soil so as to maintain productive and preserve soil.

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.

Subsoil: (B horizon) The soil horizon rich in minerals that eluviated, or leached down, from the horizons above it. Not present in all soils

Terrace: A step-like surface, bordering a stream or shoreline, that represents the former position of a flood plain, lake, or sea shore.

Topsoil: (A horizon) – The horizon that formed at the land surface. Mostly weathered minerals from parent material with a little organic matter added.

Topography: The shape of the land surface. (Relief: refers to differences in elevation of different points in a region.)

Water table: The top layer of ground water where the soil is filled with standing water. It can move up or down during different seasons.

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

SOIL SCIENCE LINKS:

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/

NRCS LINKS:

Natural Resources Conservation Service, Wyoming Homepage–http://www.nrcs.usda.gov/wps/portal/nrcs/site/wy/home/

Natural Resources Conservation Service, Soils Homepage–http://www.nrcs.usda.gov/wps/portal/nrcs/site/soils/home/

Natural Resources Conservation Service, Educational Resources–http://soils.usda.gov/education/resources/k_6/

Dig It! The Secrets of Soils (Smithsonian National Museum–http://forces.si.edu/soils/

References

Berryhill, Henry L., D.M. Brown, A. Brown and D.A. Taylor. 1950. Coal Resources of Wyoming. Geological Survey Circular 81. United States Department of the Interior, Geological Survey, Washington, D.C.

Lindbo, D.L. 2008. Soil! Get The Inside Scoop. Soil Science Society of America, Madison, WI.

Smithsonian Institution, National Museum of Natural History. Forces of Change. Dig It! The Secrets of Soil. http://forces.si.edu/soils/interactive/statesoils/index.html

State of Wyoming, Wyoming State Geological Survey. Geology of Wyoming. http://www.wsgs.wyo.gov/Research/Geology/

United States Department of Agriculture, Soil Conservation Service; USDA, Forest Service; USDI, Bureau of Land Management; WY Agricultural Experiment Station. 1986. Soil Survey of Converse County, Wyoming, Northern Part.

United States Department of Agriculture, Soil Conservation Service; USDA, Forest Service; WY Agricultural Experiment Station. 1983. Soil Survey of Crook County, Wyoming.

United States Department of Agriculture, Soil Conservation Service; USDI, Bureau of Land Management; WY Agricultural Experiment Station. 2003. Soil Survey of Niobrara County, Wyoming.

United States Depart of the Interior, U.S. Geological Survey. water.usgs.gov/lookup/getspatial?physio

Author: James Bauchert, WY state Soil Scientist

SSSA
Soil Science Society of America
5585 Guilford Road
Madison WI 53711-5801
Tel. 608-273-8080 • Fax 608-273-2021
www.soils.org
www.soils4teachers.org/state-soils

This state soil booklet was developed under the auspices of the Soil Science Society of America's K-12 Committee—their dedication to developing outreach materials for the K-12 audience makes this material possible.