KALKASKA
Michigan State Soil

SOIL SCIENCE SOCIETY OF AMERICA

Introduction

Many states have designated an official state bird, flower, fish, tree, rock, or natural resource. Similarly, each state has a state soil. A state soil is a soil that has significance or is very important to the state. Kalkaska is the state soil of Michigan. Let's explore how Kalkaska soil is important to Michigan!

History

The Kalkaska soil was established in 1927 in Kalkaska County, which is the source of its name. In 1984, the Soil Classifiers Association of Michigan, with the support of the Michigan Chapter of the Soil and Water Conservation Society, appointed a committee to nominate one soil to represent the soil resources of Michigan. The members selected the Kalkaska soil based on factors such as distribution and extent, diversified use and economic importance. In 1990 a legislative effort was made to establish Kalkaska as the "Official Michigan State Soil." On December 14, 1990 Public Act 302, the State Soil Bill, was signed by Governor James Blanchard.

What is Kalkaska Soil?

Kalkaska soil is a deep, *somewhat excessively drained* soil formed in sandy deposits left by the glaciers that once covered Michigan. Forest cover, precipitation, and good drainage all contributed to the development of a distinct and colorful profile (**Figure 1**). The surface of Kalkaska soil is black sand or loamy sand, over a light gray sandy *subsurface* layer, with a dark reddish brown, dark brown, brown and yellowish brown sandy *subsoil*, and a light yellowish brown sandy substratum. The subsurface and subsoil layers or *"horizons"* often have an irregular boundary with "*tongues"* that extend into the lower subsoil. This is due to the weathering processes that *leach* of organic matter, aluminum and iron into the subsoil. In some places there may be some weakly cemented fragments in the subsoil layer known as *"ortstein"*.

Where to dig a Kalkaska?

Yes, you can dig a soil. It is called a soil pit and it shows you the *soil profile* (see above Fig. 1). Kalkaska soil is mapped in 26 counties in the northern Lower Peninsula and Upper Peninsula **(Figure 2)**. They are of large extent and are mapped on approximately 993,235 acres. Kalkaska is one of 672 different *soil series* recognized in Michigan.

Photo Soil Monolith: Chip Clark/Smithsonian Institution

A Horizon
This horizon is the surface horizon. It is darker than other horizons as it contains the most organic matter. Organic matter coats and stains the soil particles. The organic matter comes from annual accumulation of plant material that decomposes in the soil each year.

E Horizon
This horizon is grayer than the others because organic matter, iron and aluminum have been moved downward by water.

Bhs Horizon
This horizon has an accumulation of organic matter, iron and aluminum oxides that have been leached downward from the overlying horizons. Leached organic matter is the dominant component of this horizon.

Bs Horizon
This horizon has an accumulation of organic matter, iron and aluminum oxides that have been leached downward from the overlying horizons. Leached iron and aluminum oxides are the dominant component of this horizon.

BC Horizon
This is a transitional horizon that has some features of the overlying and underlying horizons.

C Horizon
This is the unaltered parent material (the material from which the soil was formed) that was produced by the sandy deposits left by the glaciers that covered Michigan. The C horizon has little or no soil development and looks much like it did when it was first deposited.

Fig. 1. Soil profile of Kalkaska soil formed in sandy glacial deposits. (credit: USDA NRCS)

Importance

The timber industry is extremely important in Michigan and Kalkaska soils are valued for the production of hardwood timber, namely sugar maple. They are also important for producing Christmas trees and specialty crops such as potatoes. Kalkaska soils are also used as wildlife habitat areas, building sites and recreation areas.

Uses

Soils can be used for many purposes, including agriculture, recreation, engineering, wildlife habitat, building sites, and water filtration and purification. Most areas of Kalkaska soils are in forestland and are well suited for timber production. Northern hardwoods are dominant. Minor uses include Christmas tree production **(Figure 3)**, pasture, building sites, and specialty crops such as potatoes.

Limitations

The rapid *permeability* of the Kalkaska soil can cause the soil to be *droughty* at times. Seedling mortality is a major concern. Planting when the soil is moist or planting trees that can withstand dry conditions helps reduce the seedling mortality rate. In logging areas, loose sand can interfere with the traction wheeled equipment, especially during dry periods. Crop production on the Kalkaska soil typically requires irrigation.

Fig. 2. Distribution of Kalkaska soil in Michigan. Credit: Smithsonian Institution Forces of Change.

Fig. 3. Kalkaska soils have favorable conditions for growing Christmas trees. Credit: Michigan State University Extension Service.

Fig. 4. Kalkaska soil produces excellent stands of northern hardwoods. Timber harvest and processing is the leading industry in northern Lower Michigan and the Upper Peninsula where Kalkaska occurs.

Management

Kalkaska soils have a low natural fertility and low *available water capacity*. Most crops require irrigation to produce satisfactory yields. Conservation tillage, crop residue management, windbreaks and cover crops are practices which conserve moisture, help control soil blowing, and maintain soil organic matter content. Practices which increase organic matter content in the root zone also increase the ability of the soil to hold water, nutrients and pesticides, which in turn reduces the risk of groundwater pollution. On timber harvest operations loose sand can interfere with the traction of wheeled equipment in heavily traveled areas, especially during dry periods. This concern can be minimized by keeping main travel routes and landings on the most level areas possible and stabilizing these areas with gravel, wood chips, or other suitable material (**Figure. 4**). Seedling mortality can be reduced by planting tree species adapted to droughty conditions, planting when adequate soil moisture is present, and the use of containerized seedlings.

Kalkaska Soil Formation

There are five major factors that are responsible for forming a soil like the Kalkaska series. These are climate, organisms, relief, parent material and time. These factors are responsible for the development of soil profiles and the chemical properties that differentiate soils. So, the characteristics of Kalkaska soil (and all other soils) are determined by the influence of the five soil forming factors. Weathering takes place when environmental processes such as rainfall, freezing and thawing ac on rocks causing them to dissolve or fracture and break into pieces. In the case of the Kalkaska soil, most of the soil particles were broken apart from rocks in a different place, then transported by glaciers as they advanced across Michigan during the last Ice Age. After the ice melted, the Kalkaska soil started to form in the sediments that were left behind.

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. Kalkaska soil developed under the influence of the humid climate of the Upper Great Lakes region, marked by warm summers and severe winters, with no pronounced dry season. The influence of climate resulted in the *leaching* of iron, aluminum, and organic matter.

Organisms–This refers to plant and animal life. Plant roots spread through the soil, animals burrow in it, and bacteria make a living by eating (and decomposing) plant and animal tissue. Animals breakdown complex compounds into small ones and in so doing add organic matter to soil. Plants determine the kinds and amounts of organic matter that are added to a soil under normal conditions. Kalkaska soil formed under mixed coniferous and hardwood forest. The production of organic acids from decomposition of leaf litter play a major role in the development of the Kalkaska soil.

Relief–Relief describes the shape of the land (hills and valleys), and the direction it faces. This makes a difference in the amount of sunlight a soil gets and how much water it can store. The position on a landscape also has a large effect on how easily water moving through the soil can drain. Soils on high portions of landscape are usually well drained, while soils at the bottom of slopes are poorly drained. Kalkaska soils are somewhat excessively drained because of the sandy *soil texture* and because they typically form on upper landscape positions (**Figure 5**).

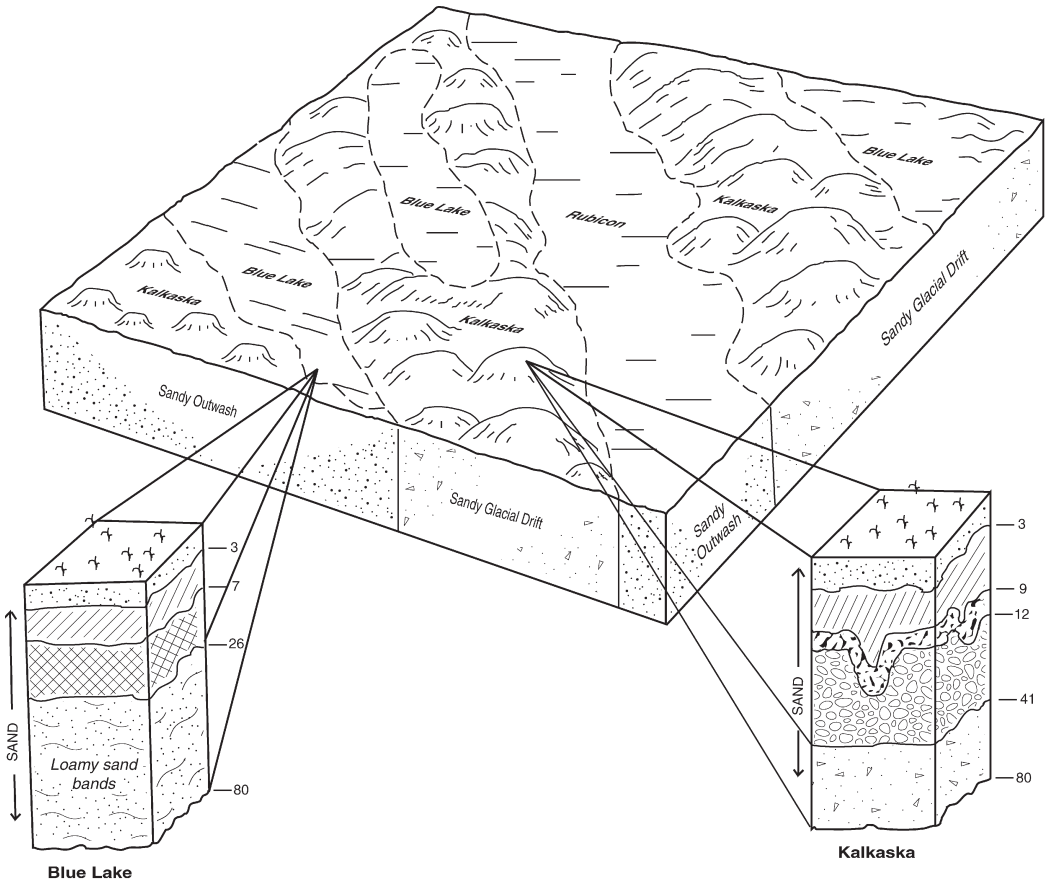

Fig. 5. Relationship of Kalkaska soil to landform position and parent material. Kalkaska soil formed in sandy glacial deposits and is located on gently rolling to rolling uplands. (credit: USDA NRCS. Soil Survey of Otsego County, MI).

Parent Material (C horizon)–Just like people inherit characteristics from their parents, every soil inherited some traits from the material from which it forms. Some parent materials are transported and deposited by glaciers, wind, water, or gravity. The state of Michigan was covered in glacial ice during the last Ice Age. Kalkaska soil developed in sandy *glacial outwash* and *glacial drift*. The sandy parent material was deposited from glacial melt-water or transported directly by the ice.

Time–All the factors act together over a very long time to produce soils. 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. Kalkaska soil has been forming since the end of the last Ice Age, about 11,000-12,000 years ago. This might sound like a long time, but it is still relatively young as far as soils go – some soils are over 1 million years old! Even though it is young, the Kalkaska soil has well defined horizons due to the significant amount of rainfall, snowmelt, leaching, and organic matter accumulation.

Ecoregions, Soils and Land Use in Michigan

Ecoregions are broad areas of land with similar environmental conditions and ecosystem resources. Soil parent materials In Michigan were formed from glacial deposits of till, fine-grained lake deposits, wind-blown materials, glacial outwash (sand and gravel) and alluvium deposited in river valleys. There are five major ecoregions in Michigan (**Figure 6**). The physiographic and ecological conditions within each ecoregion determines to a large extent the variety of land uses in Michigan. Most agriculture in Michigan occurs in the southern half of the lower peninsula where soil and climate conditions are favorable for crop production. The soils within these ecoregions formed primarily in loamy glacial deposits and clayey lake deposits. In contrast the northern half of the Lower Peninsula and the Upper Peninsula is predominantly forestland. Soils within these ecoregions formed primarily from sandy and loamy glacial drift. The soils in combination with climatic conditions make them more favorable for forestland.

Kalkaska soil occurs in the northern half of the Lower Peninsula and in the Upper Peninsula. The broad ecoregions are called the Northern Lakes Forests and North Central Hardwood Forests ecoregion. Throughout these ecoregions Kalkaska occurs in areas where the parent materials consist of sandy glacial outwash or sandy glacial drift. The broad Northern Lakes Forests and North Central Hardwood Forests ecoregions are subdivided into more specific ecoregions that denote similarities in geology, physiography, vegetation, climate and soils. Some of the specific ecoregions where Kalkaska soils can be found are the Keweenaw-Baraga Moraines, Grand Marais Lakeshore, Onaway Moraines, Vanderbilt Moraines, Manistee-Leelanau Shore and Platte River Outwash. These ecoregions are well suited for coniferous and northern hardwood forests. Hence, timber production is a major economic resource in these ecoregions.

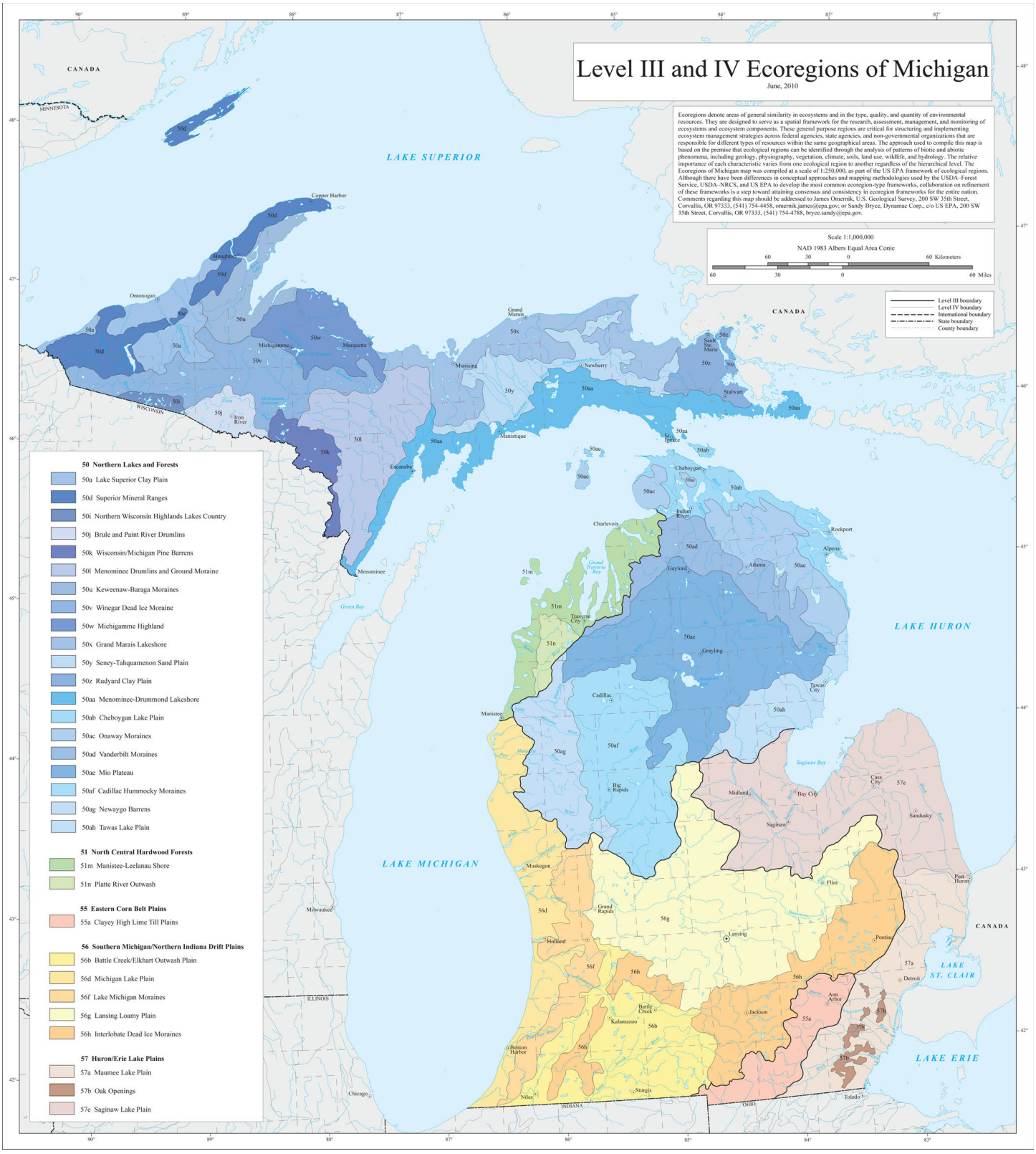

Fig. 6 Ecoregions of Michigan, Credit: US-EPA ftp://newftp.epa.gov/EPADataCommons/ORD/Ecoregions/mi/mi_eco.pdf

Glossary

Available Water Capacity: The capacity of soils to hold water available for use by most plants. It is commonly expressed as inches of water per inch of soil.

Ecoregion: Ecoregions are areas where ecosystems (and the type, quality, and quantity of environmental resources) are generally similar.

Glacial Drift: Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial Outwash: Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Horizon: *see soil horizon*

Leaching: The removal of soluble material from soil or other material by percolating water.

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

Ortstein: A cemented **Spodic Horizon.**

Permeability: The quality of the soil that enables water to move downward through the profile. It is expressed as inches per hour that water moves downward through the saturated soil.

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.

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 Series: The lowest category of U.S. system of soil taxonomy.

Soil Texture: The relative proportion of sand, silt, and clay particles that make up a soil. Sand particles are the largest and clay particles are the smallest.

Somewhat Excessively Drained: Water is removed from the soil rapidly. Internal free water occurrence commonly is very rare or very deep.

Spodic Horizon: A subsoil horizon that is characterized by accumulation of organic matter, iron and aluminum oxides that have been leached downward from the overlying horizons.

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

Substratum: (C Horizon) This is the unaltered parent material. It has little or no soil development and looks much like it did when it was first deposited.

Subsurface: (E Horizon) Part of the surface horizon that is between the surface and subsoil horizons.

Tongues: A term used that refers to penetrations of the subsurface and subsoil horizons into the lower soil profile.

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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.

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.soils.org/ask

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

Smithsonian Soils Exhibit – http://forces.si.edu/soils/

MICHIGAN LINKS:

Natural Resources Conservation Service, Michigan Homepage – www.nrcs.usda.gov/wps/portal/nrcs/site/mi/home/

Natural Resources Conservation Service – www.nrcs.usda.gov

Natural Resources Conservation Service Educational Resources www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu

References

Soil Classifiers Association of Michigan. Michigan's State Soil: The Kalkaska Soil Series

United States Department of Agriculture, Natural Resources Conservation Service. 2004. Soil Survey of Otsego County, Michigan. **US-EPA**

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