Narragansett
Rhode Island State Soil

Photo: Chip Clark/Smithsonian Institution

Soil Science Society of America

Introduction

Many states have a designated state bird, flower, fish tree, rock, etc. For example, the Rhode Island state bird is the Rhode Island Red, the state flower is the Violet, and the state tree is the Red Maple. And, the Narragansett Silt Loam is the (unofficial) state soil of Rhode Island. Let's explore how the Narragansett is important to Rhode Island.

History

The Narragansett soil series was first established in Kent and Washington Counties, Rhode Island in 1934. The soil series is named for the town where the soil was first mapped and classified. The town of Narragansett was named for the indigenous Narragansett Tribe. Narragansett is an English alteration of Nanhigganeuck, their actual name meaning "people of the small point." In 1979 an Act to designate the Narragansett Silt Loam as the Official State Soil of Rhode Island was enacted by the General Assembly, the Act did not pass the legislative process so the series is not officially considered the Rhode Island State Soil.

What is Narraganset Soil?

The Narragansett soil series consists of well drained, loamy soils that formed glacial *till* under a silty *eolian* (*loess*) cap. These soils are on upland hills, moraines, and side-slopes of hills – with slopes ranging from 0 to 25%. The average annual precipitation ranges from 40 to 55 inches. The average annual temperature is 45 to 52 degrees F. There are over 365,000 acres of the Narragansett soil mapped in Southern New England (MA, RI, and CT).

A *soil profile* of the Narragansett series shows three distinct layers called "*soil horizons*" which are clearly marked by changes in the soil color (brown-yellowish-brown-gray) (**Figure 1**). Soil horizons are layers of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes.

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 the identification of soil horizons, an uppercase letter (A, B, C, etc.) represents the major horizons and lowercase letters provide additional information about the master horizon (Ap for example – the "p" tells that the A horizon has been plowed).

Fig. 1. Narragansett Soil Profile. Credit: RI Soil Survey Staff

Fig. 2. Distribution of Narragansett soil in the state of Rhode Island. Credit: Smithsonian Institution's Forces of change. http://forces.si.edu/soils/interactive/statesoils/index.html

The horizon from 0 to 20 cm in Figure 1 is called the Ap horizon (also called *topsoil*) – it is composed of mostly *silt* sized mineral material (*silt-loam* USDA texture) and has the dark color due to the mixing of humified organic matter with the mineral soil. The thickness of the Ap and the abrupt boundary tell that this soil has been plowed and enhanced for agricultural production. The horizons from 20 to 80 cm are called the B horizons or *subsoil*. As with the Ap, the B horizon is composed of mostly silt sized particles (called loess or wind deposited material) and has yellowish-brown color due to iron oxide (rust) coating the silt particles. The combination of the A and B horizons is called the "*solum*". The layer below 80 cm is the C horizon, also called the *substratum* – the C horizon is the relatively un-weathered geologic material from which the soil formed. The C horizon of the Narragansett soil is composed of a mixture of mostly sand and some silt that was deposited by glaciers about 18,000 years ago - the glacial material is called ablation or melt-out till.

Where to dig a Narragansett Soil

Of the more than 61 soil series currently classified in Rhode Island, the Narragansett soil can be found on approximately 12,000 acres. Most of the Narragansett soils are found in uplands in central and southern portions of Rhode Island (**Figure 2**) but there are small areas not mapped throughout the state.

Importance and uses

The Narragansett silt loam soil was selected to be the state soil for Rhode Island because it is well suited for most land-uses, meaning it has few limitations that would restrict the use of the soil (**Figure 3**). It has high potential for producing food, forage, fiber, and ornamental crops. It has few use restrictions for woodland production, for community and recreational development, and for wildlife habitat. The Narragansett silt loam is considered to be one of the best soils in the state and truly represents Rhode Island's developmental and agricultural base. Where the soil is free of surface stones and boulders and occurs on level to gently sloping land it is considered a prime farmland soil by the USDA. Narragansett soils are used as a source of sand and gravel for mining operations.

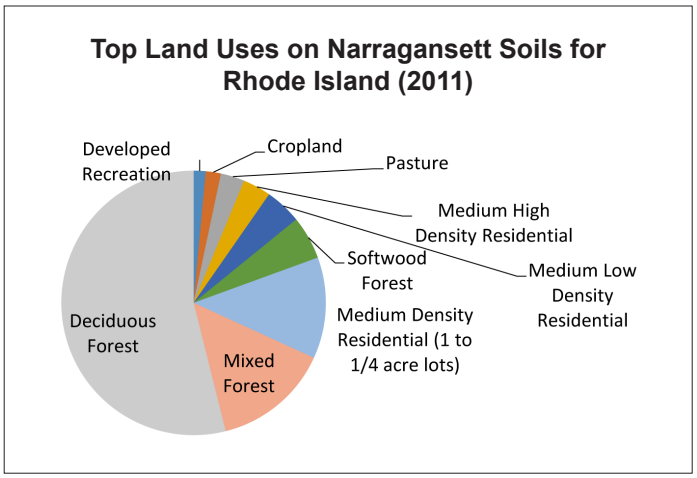

Fig. 3. Top Land Uses on Narragansett Soils for Rhode Island.

Limitations – what you can't do

Due to the high amount of silt in the soil it is subject to high *erosion* when the soil is disturbed, particularly when development is occurring on the soil. Erosion control practices must be used to minimize the solum material eroding into streams, rivers and storm drains. In some areas the Narragansett soil has large stones and boulders that can hinder excavation (**Figure 4**).

Management – taking care of the soil

Due to the thick silt-loam textured solum of the Narragansett soil they have high *available water holding capacity* for plant and trees so irrigation is generally not needed for optimal productivity except in extremely dry years. As with most soils in New England, the Narragansett soil tends to be on the acidic (low pH) side so adding lime should be added to increase the soil pH, fertility is also inherently low due to low clay content of our soils. Where the soil is being annually plowed for cultivated crops strip cropping, the use of diversions and cover crops, and the return of crop residue to the soil help to control erosion and maintain tilth and organic matter content.

Fig.4. Large stones and boulders cleared from agricultural field. Credit: RI Soil Survey Staff

Ecosystems and 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 Narragansett 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 Narragansett soil (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, glacial 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. Rhode Island is in a transitional climate zone with conditions characteristic of both humid marine and humid continental climates. The winters are quite mild for Rhode Island due to the moderating effect of the surrounding Atlantic waters. Temperature and precipitation (approximately 45-55 inches/year) govern the rate of chemical and physical weathering of the soils and allows for the accumulation of organic matter in the surface layer of the soils. Moisture is sufficient enough to promote leaching of water-soluble material down through the soil. Cold winter temperatures allow for frost action which physically breaks apart rock fragments but also frost-heave stones and boulders to the surface which have to be removed by farmers from year to year so the fields can be plowed.

Organisms – This refers to plants and animal life. In the soil, plant roots spread through, animals burrow in and bacteria eat 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 break down complex compounds into small ones and in so doing add organic matter to soil.

Narragansett soils developed under mixed hardwood (Oak and Maple) and pine forests. Hardwoods characteristically take up high nutrients (bases-calcium, magnesium, and potassium) from the soil and then recycling them by returning them to the soil surface in the form of organic litter. Coniferous trees tend to be low in these bases, consequently soils developed beneath them tend to be more acid. Worms and other macro organisms help mix and aerate the soil, in the rapidly developing areas of southern Rhode Island humans (part of the "organism" part of soil formation) impact the soil either by plowing or other mechanical disturbances used in developing the soils to houses and buildings.

Relief – Landform position or relief describes the shape of the land (hills and valleys), and the direction it faces 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. Narragansett soils are found on glaciated uplands and rolling hills (**Figure 5**) since they do not have any restrictive features that can perch water they are well drained soils and typically have bright yellowish-brown subsoils due to iron oxides coating the silt particles (photo of glaciated upland in background and plain in foreground).

Fig. 5. Narragansett soils are located on the upland hill in the background. Credit: RI Soil Survey Staff

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 Narragansett soil and many soils in Rhode Island have two very different parent materials. The lower parent material is in the C horizon and it is composed of material that was deposited within glacial ice approximately 18,000 years ago as the last continental glacier (the Wisconsinan) retreated the area. This type of till occurring in Narragansett soils is a sandy, loose type of till commonly called ablation or melt-out till. After the glacier left the region there was a dry and windy period lasting several thousand years, during this time the dust blowing in the wind was deposited and formed a cap over the glacial deposits, this cap is called eolian material. So Narragansett soils are formed in friable loess (silty eolian) that is underlain by sandy ablation till. The thickness of the loess is typically between 18 to 36 inches but can be deeper in some areas.

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. In soil science, the term "Time Zero" is used to mark the start of soil formation usually following a major geologic (or anthropogenic) event such as a landslide, volcanic eruption, excavation by a backhoe, or for the Rhode Island Time Zero event; the retreat of glacial ice to the north and exposing the barren ground. As mentioned above all of Rhode Island was covered during the Wisconsinan glaciation which reach its maximum position around 26,000 years before present and the ice was gone from RI about 18,000 years BP. This means all of the soils in Rhode Island began forming as little as 18,000 years ago which makes then very young geologically speaking. As a result the soils have very little soil development, low clay content, and are classified as being either Entisols (recently formed soils) or in the case of the Narragansett soil Inceptisols (soils just beginning to form).

Ecoregions, Soils and Land Use in Rhode Island

Most of Rhode Island lies within the Seaboard Lowland section of the New England Province of the Appalachian Highlands. A small section of the southern coastal zone and the offshore island called Block Island are located in the Embayed section of the Coastal Plain. The generalized bedrock geology of Rhode

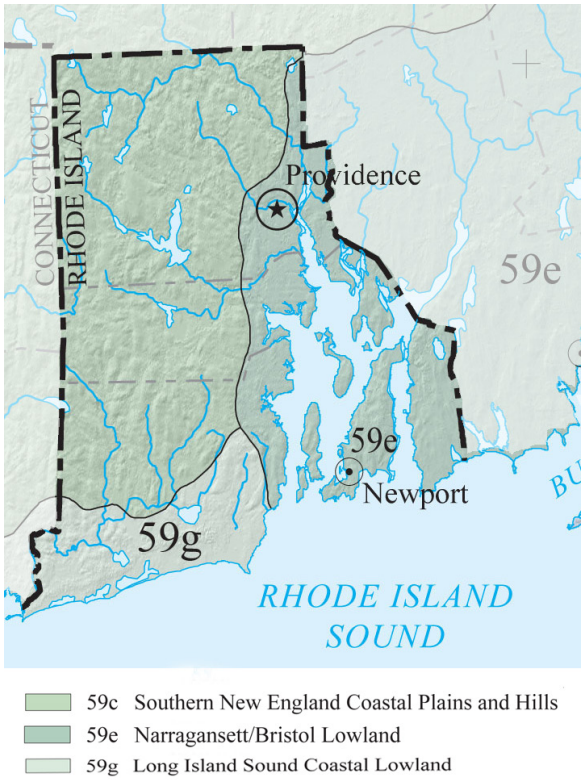

Fig. 6. Figure 6: Rhode Island ecoregions Credit: US_EPA http://ecologicalregions.info/data/ma/new_eng_front.pdf

Island shows two major bedrock types occuring; the Pennsylvanian aged Narragansett Rift Basin and the older (Proterazoic to Paleozoic) crystalline grantic rocks of the surrounding the Narragansett Basin. The soils are very different between the two bedrock types – those formed in the Narragansett Basin tend to have dark colored soils from the carboniferours shales they developed in and the soils formed in the granitic rocks tend to be sandier and yellowish-brown colored. The Narragansett soils are mainly mapped in the granitic uplands of Rhode Island.

Rhode Island has 3 ecoregions that are all within the Northeastern Coastal Zone (**Figure 6**) an area characterized by mixed oak-pine forests and dense understory. The general land-use in the area of the Narragansett soils consists of deciduous and mixed forests, urban and suburban residential and industrial complexes, scattered farmland, pastureland, and sod fields. The areas where most of the Narragansett soils are mapped are in the most rapidly developing part of Rhode Island (South County).

Glossary

Available Water Holding Capacity: The volume of water that should be available to plants if the soil, inclusive of fragments, were at field capacity. It is commonly estimated as the amount of water held between field capacity and wilting point, with corrections for salinity, fragments, and rooting depth.

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 (eolian deposit) by the wind. Includes clastic materials such as dune sands, sand sheets, and loess deposits (silts).

Erosion: The wearing away of the land surface by running water, waves, or moving ice and wind, or by such processes as mass wasting.

Geology: The study of the physical earth, its composition (materials), history and processes (physical and chemical) that act on it.

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.

Horizon: see Soil horizons

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

Loamy sand: Soil material that is a mixture of between 70-90% sand, up to 30% silt, and less than15% clay. It has more sand than sandy loam.

Loess: Material transported and deposited by wind and consisting predominantly of silt-size particles.

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.

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.

Sandy Loam: Soil material that contains between 43-85% sand, 0-50% silt and 0-50% clay. It has less sand than 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 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.

Soluble bases: Elements (calcium, magnesium, sodium and potassium) that are present in soil as ions and form what is called Cation Exchange Capacity. The amount in the soil can be reduced through leaching.

Solum: The A and B horizons of a soil profile.

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

Till (Glacial): Dominantly unsorted and unstratified drift, generally unconsolidated and deposited directly by a glacier without subsequent reworking by meltwater, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders; rock fragments of various lithologies are imbedded within a finer matrix that can range from clay to sandy loam.

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

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

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

New England Soils Information Page – http://nesoil.com

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

Discovering Alabama Teacher's Guide: Alabama Soils—http://discoveringalabama.org/wp-content/uploads/2010/05/alabama_soils.pdf

Websoilsurvey—http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

Rhode Island NRCS Soil Survey Page—http://www.nrcs.usda.gov/wps/portal/nrcs/main/ri/soils/

Soils of Rhode Island Landscapes—http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_016302.pdf

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

Rhode Island Envirothon Page—http://www.rienvirothon.org/

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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.