Soils and Land Use

INTRODUCTION:

2015 Envirothon Soil Station

There can be many uses of the word "soil", depending upon the context. For example, soil can be thought of as an engineering material for road construction, as dirt on clothing, as a mixture of ingredients for growing potted plants, or what the farmers plow every spring.

For the purposes of the regional Envirothon, "Soil is the collection of natural bodies on the earth's surface, in places modified or even made by man of earthy materials, containing living matter and supporting or capable of supporting plants out-of-doors." Soil is thus considered both a product of nature and a critical part of natural systems. This definition also allows soils to be collectively grouped into a classification system, as used in making soil surveys.

Soils "begin" as parent material, and then the process of weathering occurs. Weathering eventually causes a differentiation into distinct horizons. A soil and its profile show the effects of five soil forming factors: Climate, Living Organisms, and Topographic Relief, Parent material and Time (it may help to remember the word “CLORPT"). Soils can be considered as "young", "mature" or "old", depending upon their extent of weathering and horizon development. Soils in NY State are relatively young or mature, but not old - their parent material was exposed or deposited during the relatively recent retreat of glaciers, some 10 to 15 thousand years ago

There are a number of soil properties and limitations including: composition, texture, structure, slope, color, chemistry, profile, permeability and drainage. In addition to defining and applying these soil properties for background, a practical knowledge of the soils can be attained by using the Soil Survey, which classifies soils into series for identification, provides reference maps and interpretative tables.

Most of the soils in the U.S. are aerobic. But soils can often become saturated with water due to rainfall and flooding. When this anaerobic (no oxygen) environment continues for long periods during the growing season, different biological and chemical reactions begin to dominate. In soils where saturation with water is prolonged and is repeated for many years, unique soil properties usually develop. Soils with these unique properties are called hydric soils. These soils are important favor the formation of many types of wetlands. In fact, hydric soils were defined so that they help identify wetlands.

Soil erosion and sedimentation are separate processes, but think of them as occurring together, since once soil is eroded, it will eventually become sediment impacting water quality somewhere else. [3]Normally it takes an average of 500 years for nature to build up 1 inch of topsoil. To grow good crops agriculturally, 6 inches of topsoil are required. Since only 1/500th of an inch of topsoil is being built up naturally on the average annually in the U.S., soil is being depleted on the average each year approximately 18 times faster than it is being built up in nature.[2] (Ecology Action, 5798 Ridgewood Road, Willits, CA 95490)

Source: New York State Envirothon Web Site

Table of Contents

ENVIROTHON: SOILS/LAND USE LEARNING OBJECTIVES

- For successful completion of the soils/ land use section, contestants should be able to:
- Know the five soil forming factors, and understand how they influence soil properties.
- Understand the origin and types of soil parent materials and land forms.
- Understand basic soil forming processes: additions, losses, translocations, and transformations.
- Recognize and understand features of Soil Profiles, and be able to use this information to determine basic soil properties and limitations.
- Identify and describe soil characteristics (texture, structure, and color using Munsell color charts).
- Understand soil biological diversity and how it relates to soil health and hence plant, human and environmental health. Recognize that understanding soil ecosystems is important to soil management.
- Understand how the hydrologic, carbon and nutrient cycles relate to soil management.
- Understand that soil fertility relates to the physical and chemical properties of the soil in addition to the quantity of nutrients.
- Understand why soil fertility reflects the physical, chemical and biological state of the soil.
- Compare different land uses and conservation practices and their impact on soils and erosion.
- Understand how soil is impacted by point & non-point source pollution and practices used to address, reduce or eliminate the impact.
- Access and use published and on-line soil data and other resources to learn how land use affects soil, and the limitations of local soils.
- Understand Land Capability Classes and how they are important in determining appropriate land use.
- Understand soil drainage classes and be able to recognize the characteristics of hydric soils.

I. Soil: What is it?

A. Definition
B. Development

1) parent material
2) processes of development
3) land forms

II. Characteristics

A. Composition
B. Texture
C. Structure
D. Slope
E. Color
F. Chemistry
G. Horizons/Profile
H. Permeability/Percolation
I. Soil Water and Drainage

III. Soil Surveys (Know how to use this information)

A. Soil Series

1) what are they
2) how to use them

IV. Soil Interpretations (Know how to use this information)

A. Agriculture
B. Forestry
C. Development
D. USDA Land Use Classification

1) prime soils

V. Erosion & Sedimentation

A. Definitions
B. Types of erosion
C. Economic impacts
D. Prevention

1) Principles
2) agricultural conservation practices
3) nonagricultural conservation practices

VI. Hydric Soils

A. Definition
B. Characteristics
C. Uses/Limitations
D. Economic Value

ENVIROTHON: SOILS/LAND SKILLS

1. Use of clinometers, augers, color charts, test kits, and meters

2. Familiarity with soil pits

3. Determination of soil type by ribboning or use of particle screens

4. Basic ability to determine land use class

5. Identification of wetland indicators

6. Identify landform at site

7. Determine permeability of soil

8. Identify drainage class, depth to bedrock, depth of rooting

9. Measure thickness of topsoil, subsoil

10. Analyze soil structure and texture

11. Ability to quickly and effectively locate needed information in a soil survey

12. Using soil survey: identify hydrologic soil group; analyze chemical properties of soil; estimate erosion potential; Identify soil-mapping unit; evaluate soil type for its suitability for crops and pasture, woodland productivity, wildlife habitat, recreation, building site development and sanitary facilities.

13. Using the web-soil survey, learn the limitations that local soils have for septic systems, foundations, agriculture, and future development.

14. Determine soil characteristics and properties by describing soil horizons from a soil test pit.

Soils Terminology and General Soils Knowledge:

A soil developed in "glacial outwash" refers to its:

a) Moisture condition
b) Temperature classification
c) Parent material
d) None of the above

What size might a single sand particle be?

a) 3 millimeters
b) 3 centimeters
c) .03 millimeters

Which of the following sentences makes the most sense?

a) The consistence of the soil is friable.
b) The consistence of the soil is subangular blocky.
c) The consistence of the soil is silt loam.

Sample questions in the Soil Pit

1. One of the most important soil characteristics affecting plant growth is the rooting zone of the topsoil. What is the depth of topsoil in the soil pit?

a. 0 to 2 inches
b. 2 to 4 inches
c. 4 to 10 inches
d. 10 to 15 inches

2. Structure of the soil directly affects the ability of a plant to move and filter water throughout the soil. What is the structure of the surface horizon in the soil pit?

a. Massive
b. Single grained
c. Blocky
d. Granular

3. The solum is the upper part of the soil profile, (above the C horizon), in which the processes of soil formation are active. What is the depth of the solum in the pit?

a. 0 to 10 inches
b. 10 to 20 inches
c. 20 to 30 inches
d. Greater than 30 inches or below bottom of the pit

4. What is the surface texture of the soil in the pit?

a. Clay
b. Sandy loam
c. Silty clay
d. Silt loam

5. What is the structure of the soil in the pit between 10 to 20 inches?

a. Blocky
b. Prismatic
c. Granular
d. Single-grained

6. Redoximorphic depletions (gray mottles) are used to indicate the presence of a water table. At what depth do redoximorphic depletions occur in the soil pit?

a. 0 to 10 inches
b. 10 to 20 inches
c. 20 to 30 inches
d. Greater than 30 inches or below the bottom of the pit

7. What is the texture class of the soil in the pit between 10 to 20 inches?

a. Silt loam
b. Sandy loam
c. Sandy clay
d. Silty clay

8. Soil texture affects the ability of a soil to hold and release nutrients, which is critical in the development of sustainable local agriculture. What is the texture of the topsoil?

a. Clay
b. Sandy Clay
c. Loam
d. Silt Loam

9. Topsoil is a critical element in reducing erosion, nutrient runoff, and is also important in sustainable agriculture. What is the depth of topsoil in the soil pit?

a. 0 to 4 inches
b. 4 to 8 inches
c. 8 to 12 inches
d. 12 to 16 inches

10. Structure of the soil directly affects the ability of soil to move and filter water. What is the structure of the topsoil in the soil pit?

a. Massive
b. Single grained
c. Blocky
d. Granular

Use of Soil Survey Reports:

Web Soil Survey (WSS) provides soil data and information produced by the National Cooperative Soil Survey. It is operated by the USDA Natural Resources Conservation Service (NRCS) and provides access to the largest natural resource information system in the world. NRCS has soil maps and data available online for more than 95 percent of the nation's counties and anticipates having 100 percent in the near future. The site is updated and maintained online as the single authoritative source of soil survey information.

Soil surveys can be used for general farm, local, and wider area planning. Onsite investigation is needed in some cases, such as soil quality assessments and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center or your NRCS State Soil Scientist.

http://websoilsurvey.nrcs.usda.gov/app/

Learning Objectives:

1. Access and use published and on-line soil data and other resources to learn how land use affects soil, and the limitations of local soils.

2. Understand the eight Land Capability Classes and how they are important in determining appropriate land use.

3. Understand soil drainage classes and be able to recognize the characteristics of hydric soils and know how soils fit into the definition of wetlands.

Suggested Activities:

1. Download your local area's soil survey map to learn the limitations that local soils have for septic systems, foundations, agriculture, and future development.

2. Describe the eight Land Capability Classes and use a soil profile and site description to determine land capability class.

3. Visit your local land planning office and ask how GIS and GPS systems are used in making land use planning and development decisions. Explain how GIS and GPS can be used in learning about the soil characteristics in a wetland soil.

ENVIROTHON: SOIL SKILLS – TRUE OR FALSE?

1. Available water holding capacity is the amount of water that a soil can store and release to plant roots?
2. The physical condition of a soil as related to its ease of tillage, fitness as a seedbed and impedance to seedling emergence and root penetration is called tilth?.
3. Calcium is a soil macronutrient?
4. In a pine stand, the soil pH is generally acidic?
5. All soils will produce trees of commercial value?
6. Terrace soils refer to those soils formed in old alluvial sediments?
7. Potassium is an essential plant nutrient that is the most easily leached from the soil?
8. The presence of mottles in a soil profile indicates impeded soil drainage?
9. You would expect a soil classified as montmorillonitic to have high organic matter?
10. Munsell soil color notations are comprised of hue, value, and chroma?
11. Generally the deeper the soil, the greater the site index?
12. A field is made up of only one type of soil?
13. If harvesting were taking place, clayey soils would compact the most under normal harvest operations?
14. Soils high in coarse fragments are harder to compact than fragment free soils?
15. Wind may move soil particles by abrasion?
16. If a soil profile exhibits relatively thin layers of light and dark colored materials stratified approximately parallel to the surface, it is likely that the soil is located on a floodplain?

LAND CAPABILITY CLASSIFICATIONS

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive land forming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forestland, or for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit.

Capability classes, the broadest groups, are designated by the numbers 1 through 8. The numbers indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

> Class 1 soils have slight limitations that restrict their use.
>
> Class 2 soils have moderate limitations that restrict the choice of plants or that require moderate conservation practices.
>
> Class 3 soils have severe limitations that restrict the choice of plants or that require special conservation practices, or both.
>
> Class 4 soils have very severe limitations that restrict the choice of plants or that require very careful management, or both.
>
> Class 5 soils are subject to little or no erosion but have other limitations, impractical to remove, that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.
>
> Class 6 soils have severe limitations that make them generally unsuitable for cultivation and that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.
>
> Class 7 soils have very severe limitations that make them unsuitable for cultivation and that restrict their use mainly to grazing, forestland, or wildlife habitat.
>
> Class 8 soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreational purposes, wildlife habitat, watershed, or esthetic purposes.

Soil

From The Surface Down, 4H Soil Handbook, Soil Biology, Soil Biodiversity,
Intro to Soil Quality

Characteristics

Master Horizons & Layers, Keys to Soil Taxonomy, Soil Formation and Classification, Soil Compaction, Soil Carbon & Nitrogen, Soil Water, Soil Glue,
Soil Structure & Macropores, Assessing Soil Quality, Infiltration, Indicate, Aggregate Stability, Organic Matter, Soil Crusts

Soil Surveys

Urban Soils Primer, How to use a Soil Survey

Soil Interpretations

Water Quality and Agriculture, Soil Biology & Land Management

Erosion & Sedimentation

Building Soils for Better Crops, Understanding Soil Risks & Hazards,
Soil Quality Resource Concern-Soil Erosion, Conservation Crop Rotation,
Erosion On Construction Sites, Soil Quality Resource Concern-Soil Erosion,
Managing Soil Organic Matter, Effects of Soil Erosion

Hydric Soils

Field Indicators, Hydric Soils

WEBSITES

- USDA-NRCS Soils A site for "Helping People Understand Soils."
- Agronomy Fact Sheets
- Soil and Water Conservation Society National Science & Technology LEFT Soil Biological Communities
- Web Soil Survey (allows online viewing of soil survey maps and reports. This new application greatly enhances access to information on soils.)
- Soil Data Mart (determine if spatial and/or tabular data of soil survey is available for specific county for viewing in ArcGIS)
- Demonstrations in Soil Science The experiments listed in the "demonstrations" reference are not expected by the students, but they should be familiar with the principals behind each experiment and the soils properties that the experiments are demonstrating.
- 12 Soil Orders
- Soil Quality Resource Concerns: Soil Erosion

A

Acre: A unit of measurement of land. It is equal to the area of land inside a square that is about 209 feet on each side (43,560 square feet).

B

Bacteria: Microscopic organisms that live on water and on land. They help break down organic materials into simpler nutrients in a process called decay. Bacteria release nutrients to the soil.

Bedrock:A more or less solid layer of rock found on the surface of the land or below the soil.

C

Complex, Soil:A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Contour Stripcropping: Growing crops in strips that follow the contour. Strip of grass or close-growing crops are alternated with strip of clean-tilled crops or summer fallow.

D

Drainage Class: Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets.

E

Eluviation: The movement of material in true solution of colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Evaporation: Changing a liquid to a gas; for example, when water turns into steam or water vapor.

F

Fungi (plural of fungus): A group of non-green plants, such as molds, and mushrooms, that live on dead or dying organic matter. Fungi release nutrients to the soil.

H

Humus: Highly decomposed plant and animal residue that is a part of soil.

Hydrologic Cycle: The cycle of water movement from the atmosphere to the earth and back again through these steps; evaporation, transpiration, condensation, precipitation, percolation, runoff and storage.

L

Llluviation: The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Leaching: The removal of soluble minerals from soil by the downward movement of water.

M

Mineral: A naturally occurring inorganic substance with definite chemical and physical properties and a definite crystal structure.

Mottling, soil:irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage.

Munsell Notation:A designation of color by degrees of three simple variables hue. value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and Chroma of 4.

N

Nematodes: Microscopic, elongated worms that live on other organisms in the soil.

Nutrient: A substance that supplies nourishment for an organism to live. It can be food or chemical depending upon the organism.

Nutrient Exchange: The process by which plant roots exchange an acid for nutrients from the soil.

O

Organic Matter: Plant and animal material in various stages of decomposition that may be part of the soil.

P

Parent Material: The earthy materials both mineral and organic-from which soil is formed.

Percolation: The downward movement of water in soil.

Permeability: The quality of soil that allows air or water to move through it.

pH Value: A numerical designation of acidity and alkalinity in soil. (See Reaction, soil)

Pore Spaces: The area of the soil through which water and air move. The space between soil particles.

Precipitation: Rain, snow, and other forms of water that fall to earth.

R

Reaction, Soil: A measure of acidity or alkalinity of a soil. expressed in pH -values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline.

Regolith: The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Rock Fragments: Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root Zone: The part of the soil that can be penetrated by plant roots.

Runoff: Water that flows off land into streams and other waterways.

S

Sand: As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85% or more sand and not more than 10% clay.

Silt: As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 mm) to the lower limit of very fine sand (0.05 mm). As soil textural class, soil that is 80% or more silt and less than 12% clay.

Soil: A naturally occurring mixture of minerals, organic matter, water and air which has definite structure and composition and forms on the surface of the land.

Soil Color: The color of a sample of soil

Soil Horizon: A layer of soil that is nearly parallel to the land surface and is different from layers above and below.

Soil Mineral: That portion of the soil that is inorganic and neither air nor water.

Soil Survey: The identification, classification, mapping interpretation and explanation of the soil.

Soil Texture: The relative amounts of sand, sift, and clay in a given soil sample.

Subsoil: Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum: The part of the soil below the solum.
Subsurface Layer: Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface Layer: The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the plow layer, or the Ap horizon.

T

Top soil: The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to top dress road banks, lawns, and land affected by mining.

Z

Zone of Accumulation: The layer in a soil into which soluble compounds are moved and deposited by water.
Zone of Decomposition: Surface layers in a soil in which organic matter decays.

Zone of Leaching: The layers in a soil from which soluble nutrients are removed by water.

ENVIROTHON: SOILS / LAND USE – SOIL PRINCIPALS

Developed by a soil scientist, this guide provides a framework of principal soils topics. It may help to organize your knowledge into categories such as these while preparing for the contest.

I. SOIL CONCEPTS

A. Definition of soil - There can be many uses of the word "soil", depending upon the context. For example, soil can be thought of as an engineering material for road construction, as dirt on clothing, as a mixture of ingredients for growing potted plants, or what the farmers plow every spring. For the purposes of the Envirothon, "soil" is defined as it is in the textbook (Soil Science Simplified, 1997): "Soil is the collection of natural bodies on the earth's surface, in places modified or even made by man of earthy materials, containing living matter and supporting or capable of supporting plants out-of-doors." Soil is thus considered both a product of nature and a critical part of natural systems. This definition also allows soils to be collectively grouped into a classification system, as used in making soil surveys.

B. Soil development - a process that occurs over time.

1. Soils "begin" as parent material, and then the process of weathering occurs.
2. Weathering eventually causes a differentiation into distinct horizons.
3. A soil and its profile show the effects of five soil-forming factors: Climate, Living Organisms,

Topographic Relief, Parent material and Time (it may help to remember the word "CLORPT"). Soils can be considered as "young", "mature" or "old", depending upon their extent of weathering and horizon development. Soils in NY State are relatively young or mature, but not old - their parent material was exposed or deposited during the relatively recent retreat of glaciers, some 10 to 15 thousand years ago.

II. SOIL CHARACTERISTICS

A. Composition - About a 50%-50% mix of solids and open space; voids may hold water or air.

B. Texture - refers to soil particle size, sand = 2 to 0.05 mm; silt = 0.05 to 0.002 mm; clay = < 0.002 mm. Soil texture influences water storage & movement, fertility, and workability or "tilth".
c "Loam" is a name for one of various mixtures of these three particle sizes.

C. Structure - the arrangement of soil particles into aggregates, which may have various shapes, sizes and degrees of development or expression. Soil structure influences aeration, water movement, erosion resistance, and root penetration.

D. Slope - the inclination of the ground surface. Slope influences runoff of rainfall, soil erosion, stability, and machinery operation.

E. Color - Soil color often indicates soil moisture status and is used for determining hydric soils. Often described using general terms, such as dark brown, yellowish brown, etc., soil colors are also described more technically by using Munsell soil color charts, which separate color into components of hue (relation to red, yellow and blue), value (lightness or darkness) and chroma (paleness or strength).
F. Chemistry - A complex subject within soil science; the most important subjects are: pH - The acidity or alkalinity of soils, which affects plant growth and soil fertility.

G. The soil profile - A vertical cut that exposes soil layering or horizons are formed by combined biological, chemical and physical alterations. A, B, and C symbols are used to describe the topsoil, subsoil and substratum, respectively.

H. Permeability - The ability of a soil to transmit water or air. Faster or greater permeability often occurs in sandy or gravelly soils due to large pore spaces. Slower permeability typically occurs in finer textured clay soils, or compacted soils with little structure.

I. Drainage - The rate in which water is removed from a soil. Drainage influences most uses of soils, whether for agriculture, silviculture or urban. Classes of soil drainage are those found in soil survey reports, such as well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained. Soil color patterns (such as mottle patterns or redoximorphic features) often indicate soil drainage class. Most productive agricultural soils in NY are well drained or moderately well drained. By contrast, hydric soils are poorly or very poorly drained. A soil's natural drainage rate can be significantly increased by subsurface "tile" drainage.

III. SOIL SURVEY MAPS

A. Soil Series - A level of Soil Taxonomy, the soil classification system used in making soil surveys. One example is the "Mardin Series".

IV. SOIL SURVEY INTERPRETATIONS

Become familiar with the interpretive tables within a relatively modern soil survey (since about 1970). These commonly include soil suitability for uses such as:

A. Agriculture

V. EROSION AND SEDIMENTATION

These are separate processes, but think of them as occurring together, since once soil is eroded it will eventually become sediment somewhere. A. Erosion is the "wearing away" of land by the action of water, wind or ice. It is a natural, geologic process, but often is greatly accelerated by man's activities.

VI. HYDRIC SOILS

A. Introduction Most of the soils in the U.S. are aerobic. This is important to our food, fiber and forest production because plant roots respire (that is, they consume oxygen and carbohydrates while releasing $CO2$) and there must be sufficient air - especially oxygen - in the soil to support root life. As mentioned in the textbook (Soil Science Simplified), air normally moves through interconnected pores by forces such as changes in atmospheric pressure, turbulent wind, the flushing action of rainwater, and by simple diffusion.

In addition to plant roots, most forms of soil microorganisms need oxygen to survive. This is true of the more well-known soil animals as well, such as ants, earthworms and moles. But soils can often become saturated with water due to rainfall and flooding. Air travels very slowly (some 10,000 times slower) when soil becomes saturated with water because there are no open passageways for air to travel. When oxygen levels become limited, intense competition arises between soil life forms for the remaining oxygen. When this anaerobic (no oxygen) environment continues for long periods during the growing season (April to October in most of NY), quite different biological and chemical reactions begin to dominate, compared with aerobic soils. In soils where saturation with water is prolonged and is repeated for many years, unique soil properties usually develop that can be recognized in the field. Soils with these unique properties are called Hydric Soils, and although they may occupy a relatively small portion of the landscape, they maintain important functions in the environment.

B. Why are hydric soils important? The environmental conditions that create hydric soils (water remaining at or near the soil surface for extended time periods during the growing season) also favor the formation of many types of wetlands.

Wetlands play important roles in the environment, some of which we have only begun to understand and appreciate. Groundwater is recharged or restored by entering some wetlands; however, in New York soils it is probably just as common that groundwater discharges (exits) to become surface water through wetlands. During periods of heavy rains or melting snow, flooding can present a real danger to people and property; but because wetlands occupy depressions in the landscape they can trap and thereby detain flood waters, thus reducing downstream damages. Wetlands are often difficult places for humans to physically move around in, so most people avoid them; this is one reason that they provide critical habitat for many rare and endangered species of flora and fauna. Because wetlands often occur in relatively low elevations, they commonly receive polluted waters from man's activities on higher, drier ground; wetlands can effectively filter these waters and retain excess nutrients. Wetlands are also valuable for recreation, including nature appreciation, hunting, fishing, canoeing, etc.

Due to historical and present development pressures, the number and extent of wetlands has been greatly diminished (by about 50%) in the United States since the time when the first white settlers arrived. Within the last 10 to 20 years, political debates and new regulations have focused on methods to conserve and rehabilitate wetlands. Because they are formed in association with wetlands, hydric soils can be used to identify the presence and boundaries of wetlands. In fact, hydric soils were defined so that they help identify wetlands. Along with unique vegetation and hydrology, hydric soils are one of the three required indicators for wetland identification. As a result, hydric soils are a very important issue in land management and land planning across the United States due to their role in the identification of wetlands and their function in wetland ecology.

C. Defining hydric soils various government agencies are involved with wetland protection. The NY State Department of Environmental Conservation (DEC) protects wetlands over 5 hectares (12.4 acres) in size. The US Department of Agriculture Natural Resources Conservation Service identifies and protects wetlands that have been used for agriculture.

The US Army Corps of Engineers protects wetlands of practically any size. With the help of soil scientists, they have defined hydric soils, which they consider to be those soils which are developed under sufficiently wet conditions to support the growth and regeneration of hydrophytic vegetation:
A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part.

This definition can be broken up into three component parts:

1) The soil is saturated, flooded or ponded. Saturated conditions are often the result of a high water table. Flooded conditions are produced by overflowing streams, runoff from higher surrounding slopes or from high tides that inundate coastal wetlands. Ponded conditions are produced by higher water inflow than water outflow from a closed depression.

2) Wet conditions occur during the growing season. This is the period of time when the soil is above 5oC or approximately 40oF. Above this temperature, biological activity is significant and many plants are able to grow.

3) The soil is wet long enough to develop anaerobic conditions in the upper part. The vast majority of soil biological activity occurs at or near the soil surface. When the soil is biologically active, a few weeks of wet conditions is usually adequate to use up available oxygen; however, this can be affected by many factors (e.g. soil and water temperature, the oxygen content of the water, soil organic matter content, soil permeability, etc.). The important thing is that anaerobic conditions result often or long enough to support mostly hydrophytic (water-loving) plants. Further, much of the biological activity in soils is engaged in the decomposition of organic matter either deposited within or on the soil surface. When oxygen is not available to the soil flora and fauna, biological activity is greatly reduced. As a result, organic material builds up in the soil. Additionally as a result of the wet, anaerobic environment the soil takes on a characteristic reducing condition and undergoes chemical reactions that are different than non-hydric soils.

D. Hydric soil properties and indicators the physical, chemical and biological properties which make hydric soils recognizable are the result of complex bio-geochemical processes occurring over many years.

Hydric soils usually have a water table, or the top of a zone of saturation, within one foot from the soil surface during the growing season. This shallow water table excludes oxygen and so creates a reducing environment, especially in the upper part of the soil profile. As a result, mostly hydrophytic plants proliferate - such as rushes, cattails, sedges and skunk cabbage.

Most soils, including hydric soils, are dominantly composed of minerals such as quartz, feldspars, clay minerals, etc. However, hydric soils commonly have a buildup of organic matter at the soil surface, for reasons described above, which can make the surface horizon dark, colored. If the organic matter content (measured as organic carbon) is greater than 20 to 30% of the soil's weight (depending upon clay content) and this organic-rich layer is over 16 inches thick, then it is considered an organic soil. Most soil organic matter originates as plant tissue, so organic soils are called Histosols (the Greek word for tissue is histose). Many types of organic soils exist, but they can be classified by their thickness and degree of decomposition (see chapter 12 of text). Peat, such as common "peat moss", is mostly composed of recognizable plant fragments that are only partly decomposed. Muck contains highly decomposed organic matter and, when drained of excess water and carefully managed, these black and spongy soils comprise some of the most important vegetable-producing soils in the eastern US. Another property unique to hydric soils is their color or color patterns. Besides the dark shading from the presence of organic matter, iron compounds are the most important coloring agents in soils. Hydric soils tend to exhibit gray or blue-gray colors (known as gleying or gleyed colors) especially just beneath the topsoil or surface horizon (see lower portion of photograph). This results from the chemically reduced oxidation state of iron compounds, as opposed to the rusty red (oxidized) and brown colors of drier, non-hydric soils. Where shallow water tables fluctuate, gray, yellow and red colors can also occur as small splotches, threadlike or network patterns, created by accumulations or depletions of iron and manganese (orange colors in photograph). Because they result from processes of reduction and oxidation these color indicators of wetness are collectively termed redoximorphic features.

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What do Soil Scientist Do?

The earth's ecosystem relies on the soil as a foundation from which to build. Soil Scientists teach people what soil is and how it interacts with other components of our ecosystem. They study and research soil formation, classification and engage in soil mapping (i.e. soil surveys). They investigate the chemical and biological properties of soil and how these support life above ground. They also strive to find sustainable management and usage guidelines which will benefit crop production, environmental quality, waste management, recycling and wildlife.

Soil Scientists often work for the federal government but also find work with non-profit environmental groups, consulting firms or private practice. In the government sector, soil scientists can work for the Bureau of land Management (BlM), or a state's environmental agency. They work on comprehensive soil surveys and interact with the public offering tips on the best management practices for land use, plant growth and erosion control. Soil Scientists often act as consultants working with engineers on construction projects or technicians on soil problems, and often they deal with waste management and groundwater issues.

Soil Scientists spend much of their time outdoors, conducting soil testing and gathering information about the relationship between different soil properties and plant growth. Soil Scientists require at least a four year bachelor's degree from an accredited university, and usually a master's degree or higher to work in research positions. Students will study a range of disciplines including biology, geology, chemistry and hydrology. Recent graduates often make between $40,000 and $65,000 per year. Soil Science is integral to understanding the world we live in and to supporting the health of our ecological community. The demand for Soil Scientists will be steady as our nation strives to live in sustainable harmony with our environment.

Source: NYC Envirothon Resource Packet

References:

National Envirothon www.envirothon.org/
NY State Envirothon www.nysenvirothon.net/

Notes