SOILS ENVIROTHON TRAINING
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I.	Registration and Introductions	9:00 – 9:10
II.	Soil Properties	9:10 – 10:00
III.	Pit 1	10:10 – 10:45
IV.	Slopes	10:55 – 11:30
V.	Pit 2	11:40 – 12:15
VI.	Maps/Interpretations	12:25 – 1:00
VII.	Test Questions	1:10 – 1:30

Envirothon Study Guide
Soils

Soil Profile

- How to measure depth of horizons
- Characteristics of various horizons
- Parent material (alluvium, colluvium, sedimentary, igneous, metamorphic)
- Mottles
- Gleying
- Depth of soil (deep, moderate, shallow)

Soil Survey

- Soil Series
- Land capability class
- Potential for woodland, wildlife, crop production
- Land Uses/Limitations (building house, pond, septic, landfill, recreation)
- Soil map unit
- Drainage
- Uplands
- Floodplain
- Crop yields

Properties of Soils (40" Soil Column)

- Texture (coarse, moderately coarse, medium, moderately fine, fine)
- Moisture holding capacity
- Soil Drainage Class (well, moderate, poorly drained)
- Soil Composition (mineral, water, air, organic material)
- Permeability
- Erosion Potential
- Stoniness
- Color
- Water Capacity
- Anaerobic
- Minerals

Factors in soil formation (climate, parent material, living organisms, topography, time)

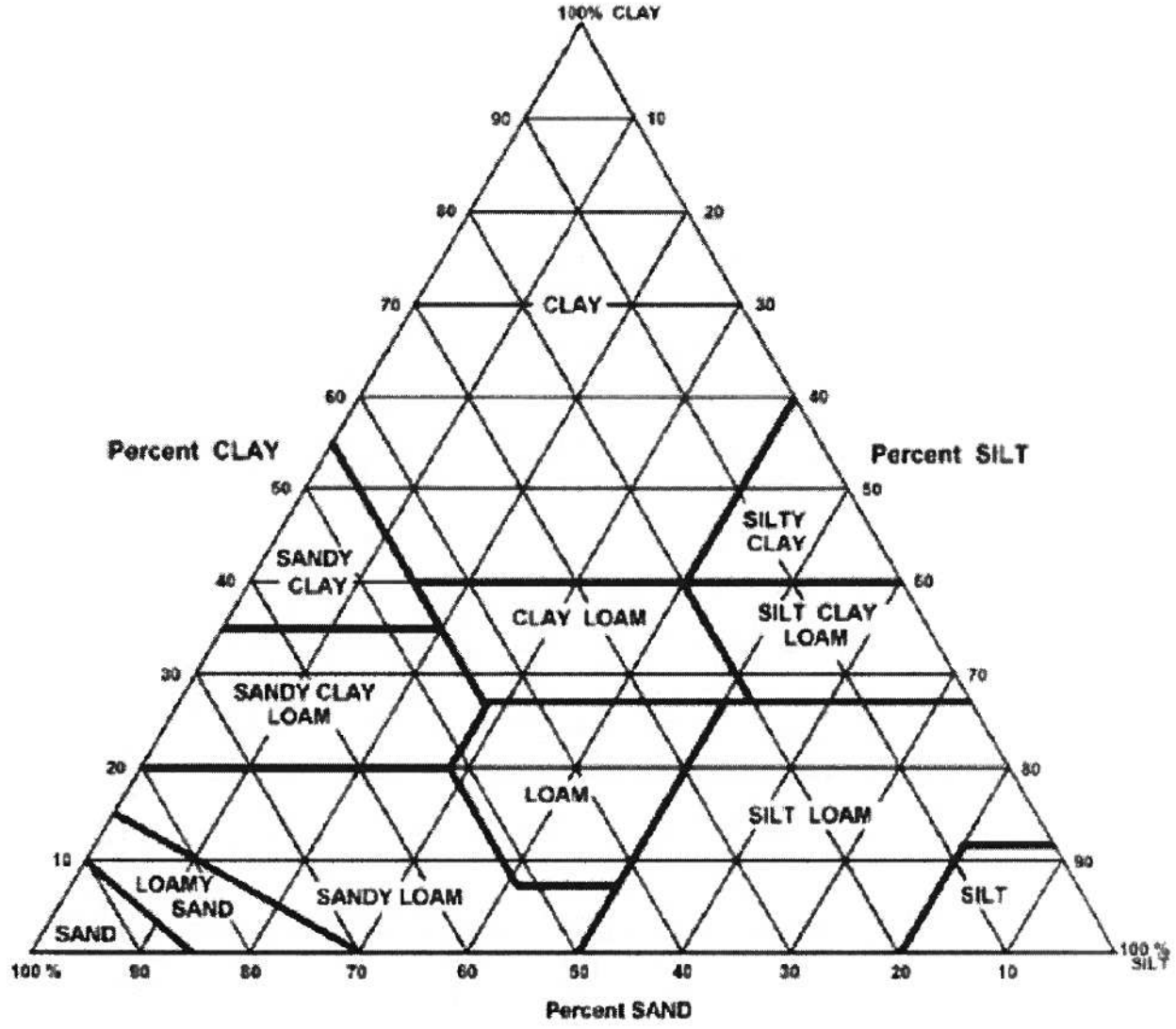
Slope

- Measurement
- Limitations (steep slopes)

Soil Test (nitrogen, phosphorus, pH)

Conservation Plan

Figure 1: Graph showing the percentages of sand, silt, and clay in the soil texture classes



Soils

INTRODUCTION:

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, then the process of weathering occurs. Weathering eventually causes a differentiation into distinct horizons. A soil and its profile show the effects of five soilforming 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. 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 yearapproximately 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

OBJECTIVES:

- Recognize soil as an important and dynamic resource.
- Recognize and understand the features of a soil profile.
- Describe basic soil properties and soil formation factors.
- Explain the origin of soil parent materials.
- Identify and list soil characteristics (e.g. , texture, structure, etc.) and their relation to soil properties.
- Determine basic soil properties and limitations (e.g., mottling and permeability) by

observing a
soil pit or a soil profile.
• Recognize the characteristics of wetland (hydric) soils.
• Explain soil drainage classes and understand how wetlands are defined.
• Describe soil water, its movement, storage and uptake by plants.
• Cite the effects of land use on soils.
• In land use planning decisions, discuss how soil is a factor in or is impacted by non-point source pollution.
• Identify types of soil erosion and discuss methods for reducing erosion.
• Utilize soil information, including a soil survey.
Source: Canon Envirothon Objectives Soils

OUTLINE:

I. Soils and Ecosystems
- A. Soil an Important Natural Resource
- B. Basic Interrelationships between Soil and the other Components of an Ecosystem
  1. involved in major nutrient cycles
  2. Involved in successional stages
  3. soil-plant interactions: nutrient transfer, decomposition/organic matter, erosion prevention, fertility/productivity, soil a matrix/mechanical support
  4. soil-water interactions: filtration, eluviation/illuviation, holding capacity, erosion effects, wetlands including definition of hydric soils, water table, aquifer recharge

II. Soil Forming Factors: Parent Material, Climate, Plant/Animal Life, Topography, Time

III. Soil Drainage Classes
- A. Definition and Delineation of Wetlands
- B. Hydric Soils: Physical/Chemical Characteristics
  1. testing for hydric soils

IV. Soil Properties: By Observing a Soil Pit or Soil Profile
- A. Define and Provide Application for Major Soil Properties and Limitations such as: texture, structure, color, chemical content, slope, water content, permeability, mottling, permeability, consistence, aggregation, cation exchange capacity, pH

V. Soil Composition
- A. Major Components of Soil: air, water, minerals, organic matter
- B. Major Soil Types: sand, clay, loam
- C. Soil Particles: sand, silt, clay
- D. Use of Soil Triangle

VI. Soil Profile: Differentiation of Soil Horizons

VII. Soil Survey Document
- A. History, Status and Current Applications of the Survey

B. Knowledge and Use of Soil Series, Soil Interpretations
C. Basic Working Knowledge of Survey Format and Information
D. Ability to Use Aerial Photomaps
E. Land Use Capability Classification System: Operation and Application
F. Geographical Database: Usage/Application

VIII. Soil Quality Indicators: Aggregate Stability, Organic Matter, Crusts, and Infiltration

IX. Soil Resource Concerns
A. Examples: compaction, erosion (types), sediment deposition
B. Identification of Concerns
C. Identification of Specific Best Management Practices
D. Soil: a Factor in, or Impacted by Nonpoint Source Pollution

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.

Master Horizons and Layers

O horizons-Layers dominated by organic material.

A horizons-Mineral horizons that formed at the surface or below an O horizon that exhibit obliteration of all or much of the original rock structure and (i) are characterized by an accumulation of humified organic matter intimately mixed with the mineral fraction and not dominated by properties characteristic of E or B horizons; or (ii) have properties resulting from cultivation, pasturing, or similar kinds of disturbance.

E horizons-Mineral horizons in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these, leaving a concentration of sand and silt particles of quartz or other resistant materials.

B horizons-Horizons that formed below an A, E, or O horizon and are dominated by obliteration of all or much of the original rock structure and show one or more of the following:

1. illuvial concentration of silicate clay, iron, aluminum, humus, carbonates, gypsum, or silica, alone or in combination;
2. evidence of removal of carbonates;
3. residual concentration of sesquioxides;
4. coatings of sesquioxides that make the horizon conspicuously lower in value, higher in chroma, or redder in hue than overlying and underlying horizons without apparent illuviation of iron;
5. alteration that forms silicate clay or liberates oxides or both and that forms granular, blocky, or prismatic structure if volume changes accompany changes in moisture content; or
6. brittleness.

C horizons or layers-Horizons or layers, excluding hard bedrock, that are little affected by pedogenic processes and lack properties of O, A, E, or B horizons. The material of C horizons may be either like or unlike that from which the solum presumably formed. The C horizon may have been modified even if there is no evidence of pedogenesis.
R layers-Hard bedrock including granite, basalt, quartzite and indurated limestone or sandstone that is sufficiently coherent to make hand digging impractical.

Hydric Soils - Overview

The Hydric Soils section presents the most current information about hydric soils. It updates information that was previously published in "Hydric Soils of the United States" and coordinates it with information that has been published in the "Federal Register". It also includes the most recent set of field indicators of hydric soils.

Four types of technical information about hydric soils are presented.

1. The current definition of a hydric soil -- This definition has been consistent in the overall concept that hydric soils are those soils that are sufficiently wet in the upper part to develop anaerobic conditions during the growing season.

2. The criteria for hydric soils and the lists which are generated from them -- The criteria are selected soil properties that are documented in Soil Taxonomy and were designed primarily to generate a list of hydric soils from soil survey databases. These criteria **CANNOT** be used in the field to determine hydric soils. The purpose of the criteria is to generate a list of soil map unit components that are **likely** to meet the hydric soil definition. Caution must be used when comparing the list of hydric components to soil survey maps. Many of the soils on the list have ranges in water table depths that allow the soil component to range from hydric to nonhydric depending on the location. Lists of hydric soils along with soil survey maps are good off-site ancillary tools to assist in wetland determinations, but they are not a substitute for observations made during on-site investigations.

3. The list of **field** indicators of hydric soils -- The **field** indicators are morphological properties known to be associated with soils that meet the definition of a hydric soil. Presence of one or more field indicators suggests that the processes associated with hydric soil formation have taken place on the site being observed. The field indicators are essential for hydric soil identification because once formed, they persist in the soil during both wet and dry seasonal periods.

4. The Hydric Soil Technical Notes -- Contain National Technical Committee for Hydric Soils (NTCHS) updates, insights, standards, and clarifications.

Next item -- Introduction

Hydric Soils - Introduction

Definition

The definition of a hydric soil is a soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part.

Field Indicators

Field Indicators are soil characteristics which are documented to be strictly associated only with hydric soils. Field Indicators are an efficient on-site means to confirm the presence of hydric soil. The Field Indicators are designed to identify soils which meet the hydric soil definition without further data collection. Some hydric soils exist for which no Field Indicators have yet been recorded and documented, and to identify these soils as hydric, evidence must be gathered to demonstrate that the definition is met. Additional Field Indicators are being developed and tested.

Concept

The concept of hydric soils includes soils developed under sufficiently wet conditions to support the growth and regeneration of hydrophytic vegetation. Soils that are sufficiently wet because of artificial measures are included in the concept of hydric soils. Also, soils in which the hydrology has been artificially modified are hydric if the soil, in an unaltered state, was hydric. Some series, designated as hydric, have phases that are not hydric depending on water table, flooding, and ponding characteristics.

Hydric Soils Lists

The lists of hydric soils were created by using criteria that were developed by the National Technical Committee for Hydric Soils. The criteria are selected soil properties that are documented in Soil Taxonomy (Soil Survey Staff , 1999) and were designed primarily to generate a list of hydric soils from the National Soil Information System (NASIS) database.

Hydric soil lists have a number of agricultural and nonagricultural applications. These include assistance in land-use planning, conservation planning, and assessment of potential wildlife habitat. A combination of the hydric soil, hydrophytic vegetation, and hydrology criteria defines wetlands as described in the National Food Security Act Manual (Soil Conservation Service, 1994) and the Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory, 1987) which is currently being regionalized. Therefore, an area that meets the hydric soil criteria must also meet the

hydrophytic vegetation and wetland hydrology criteria in order for it to be classified as a jurisdictional wetland.

The national list of hydric soils is maintained in a computer file and is updated yearly. The most current national electronic list of hydric soils may be obtained directly from this website. State lists of hydric soils are also available electronically from this site or as hardcopy from the NRCS State Conservationist in each state. The NRCS also maintains, for each conservation district in the United States, lists of map units that contain, or may, in some delineations, contain hydric soils. These detailed lists are available by contacting your NRCS State Conservationist and are recommended only for preliminary use in making wetland determinations. Field Indicators must be used for on-site determinations of hydric soils.

Literature Cited

Environmental Laboratory. 1987. *Corps of Engineers Wetland Delineation Manual, Technical Report Y-87-1*, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Soil Conservation Service. 1994. *National Food Security Act Manual. Title 180.* USDA Soil Conservation Service, Washington, D.C.

Soil Survey Staff. 1999. *Soil Taxonomy: A Basic System of Soil Classification for Making and Interpreting Soil Surveys.* USDA Natural Resources Conservation Service, Agric. Hdbk. 436, U.S. Government Printing Office, Washington, D.C. 869 pp.

Soil Survey Staff. 1994. *National Soil Survey Handbook.* USDA Soil Conservation Service, Washington, D.C.

Next item -- Criteria

Hydric Soils - Criteria

The following NASIS criteria reflect those soils that may meet the definition of hydric soils. Criteria 1, 3, and 4 serve as both database criteria and as field indicators for identification of hydric soils. Criterion 2 serves only to retrieve soils from the database. In addition, the wording of criteria 1 and 2 were changed in 2000 to incorporate recent changes in Soil Taxonomy (Soil Survey Staff, 1999). **Please note that these changes did not cause any soils to be added or deleted from the list.**

1. All Histels except Folistels and Histosols except Folists, or

2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that are:

   a. Somewhat poorly drained with a water table* equal to 0.0 foot (ft) from the surface during the growing season, or

   b. poorly drained or very poorly drained and have either:

      i. water table* equal to 0.0 ft during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches (in),

      or for other soils

      ii. water table* at less than or equal to 0.5 ft from the surface during the growing season if permeability is equal to or greater than 6.0 in/hour (h) in all layers within 20 in,

      or

      iii. water table* at less than or equal to 1.0 ft from the surface during the growing season if permeability is less than 6.0 in/h in any layer within 20 in, or

3. Soils that are frequently ponded for long duration or very long duration during the growing season, or

4. Soils that are frequently flooded for long duration or very long duration during the growing season.

Glossary

anaerobic: a situation in which molecular oxygen is virtually absent from the environment.
artificial hydric soil: a soil that meets the definition of a hydric soil as a result of an artificially induced hydrologic regime and did not meet the definition before the artificial measures were applied.
biologic zero: the soil temperature, at a depth of 50 cm (19.7"), below which the growth and function of locally adapted plants are negligible.

drained: a condition in which ground or surface water has been removed by artificial means.

flooded: a condition in which the soil surface is temporarily covered with flowing water from any source, such as streams overflowing their banks, runoff from adjacent or surrounding slopes, inflow from the high tides, or any combination of sources.

frequently flooded, ponded, saturated: a frequency class in which flooding, ponding, or saturation is likely to occur often under usual weather conditions (more than 50 percent chance in any year, or more than 50 times in 100 years).

growing season: the portion of the year when soil temperatures are above biologic zero at 50 cm (19.7"). The following growing season months are assumed for each of the soil temperature regimes of Soil Taxonomy:

Isohyperthermic	January-December
Hyperthermic	February-December
Isothermic	January-December
Thermic	February-October
Isomesic	January-December
Mesic	March-October
Frigid	May-September
Isofrigid	May-September
Cryic	June-August
Hypergelic	July-August
Pergelic	July-August
Subgelic	July-August

hydrophytic vegetation: plant life growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content.

long duration: a duration class in which innundation for a single event ranges from 7 days to 1 month.

permeability: the ease with which water passes through a bulk mass of soil or a layer of soil. In the Map Unit Interpretation Record (MUIR) database, permeability is expressed as the number of inches per hour that water moves downward through the saturated soil.

phase, soil: a subdivision of a soil series based on features that affect its use and management (e.g. slope, surface texture, stoniness, and thickness).

ponded: a condition in which water stands in a closed depression. The water is removed only by percolation, evaporation, or transpiration.

poorly drained: water is removed from the soil so slowly that the soil is saturated periodically during the growing season or remains wet for long periods.

saturated: a condition in which all voids (pores) between soil particles are filled with water.

soil series: a group of soils having horizons similar in differentiating characteristics and arrangements in the soil profile, except for texture of the surface layer.

somewhat poorly drained: water is removed slowly enough that the soil is wet for significant periods during the growing season.

very long duration: a duration class in which innundation for a single event is greater than 1 month.

very poorly drained: water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season.

***water table:** the upper surface of ground water where the water is at atmospheric pressure. In the Map Unit Interpretation Record (MUIR) database, entries are made for the zone of saturation at the highest average depth during the wettest season. It is at least six inches thick and persists in the soil for more than a few weeks. In other databases, saturation, as defined in Soil Taxonomy (Soil Survey Staff. 1999), is used to identify conditions that refer to water table in Criteria 2.

WEB sites for additional information on Soils

1. WEB Soil Survey - http://websoilsurvey.nrcs.usda.gov/app/
2. Soils Data Mart - http://soildatamart.nrcs.usda.gov/
3. Soils Descriptions - http://soils.usda.gov/technical/classification/osd/index.html
4. Ortho photos of Delaware - http://www.udel.edu/FREC/spatlab/
5. Soil Science Society of America - https://www.soils.org/
6. Soil Science Education Home Page - http://soil.gsfc.nasa.gov/
7. Glossary of Soil Science Terms - https://www.soils.org/sssagloss/?check
8. Sussex Conservation District - http://sussexconservation.org/news.htm
9. Kent Conservation District - http://kentcd.org/