Introduction to Soil Science and Wetlands – Kids at Wilderness Camp

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Soils Defined

- Natural Body that Occurs on the Land Surface that are Characterized by One or More of the Following:
  - Consists of Distinct Horizons or Layers
  - The Ability to Support Rooted Plants in a Natural Environment
  - Upper Limit is Air or Shallow Water
  - Lower Limit is Bedrock or Limit of Biological Activity
  - Classification based on a typical depth of 2 m or approximately 6.0 feet
Another Definition of Soils

• A Natural 3 - Dimensional Body at the Earth Surface
• Capable of Supporting Plants
• Properties are the Result of Parent Material, Climate, Living Matter, Landscape Position and Time.
• Soil Composed of 4 Components (mineral matter, organic matter, air, and water)
The Regolith – What?

- The Regolith is the Unconsolidated material overlying Rock. The Overburden!

- This material may be rather thin to hundreds of feet thick and can include material dislodged or weathered from local rock, transported to the area by wind, water, ice, or gravity.

Image Source: http://soils.ag.uidaho.edu
The Soil or Solum

- The Soil or Solum is the portion of the Regolith that has been influenced by the 5 Soil Formation Factors.

- The processes are controlled by Time, Climate, Topography (Landform and Position), Organisms, and Parent Material.

- Formation Process are in 4 Broad Categories (additions, losses, translocation, and transformations)- Genetic Soil Forming Processes.
Five Soil Formation Factors

- Organisms
- Climate
- Time
- Topography and Landscape Setting
- Parent Material
Soil Food Web - Organisms

- Micro & Macroscopic
- Decomposition of Organic Matter
- Animals Living in Soil
- Vegetation Types
- Human Activity
- Redoximorphic Feature Formation

Image Source: The University of Minnesota, 2003
Climatic Elements (Energy & Precipitation)

- Annual and Seasonal Rainfall
- Temperature Range
- Biologic Production and Activity
- Weathering (Wind, Water, and Ice - Physical breakdown)
- Translocation of Material
Climate and Soil Development

Image Source: University of Wisconsin, 2002
Geologic Time

Time

Disintegrating rock
Bedrock

Parent material
C horizon

Mineral fragments and organic matter
Humus
A horizon

Parent material
C horizon

Organic matter

A horizon

B horizon
Landscape and Relief (Soil Texture)

A- Sandy Texture and Loamy Sand
B- Sandy Textures
C- Clay Loam, Loam, Silt Loam

Image Source: University of Wisconsin, 2002
Landscape and Relief (Drainage)

Water Movement
Soil Drainage
Landscape Configuration (Convex, Concave)
Elevation
Water Movement

Image Source: NJ NRCS, 2002
Parent Material

- Geological Materials
  - Minerals and Rocks
  - Glacial Materials
  - Loess (wind blown)
  - Alluvial Deposits
  - Marine Deposits
  - Organic Deposits

- Influences
  - Minerals Present
  - Colors
  - Chemical Reactions
  - Water Movement
  - Soil Development
Major Components of Soil

Pore Space (50%)
- This may contain air and/or water

Soil Space (50%)
- Organic Matter
- Mineral Matter
Soil Horizons

- Layer of Soil Parallel to Surface
- Properties a function of climate, landscape setting, parent material, biological activity, and other soil forming processes.
- Horizons (A, E, B, C, R, etc)

Image Source: University of Texas, 2002
Master Soil Horizons

- O Horizon - leaf litter / humus
- A Horizon - organic accumulation in mineral soil
- E Horizon - leached horizon (elluviation)
- B Horizon - zone of illuviation
- C Horizon – unconsolidated parent material
- R Horizon – lithic material (Rock)

Not All the Master Horizons Will Be Present in All Profiles
Soil Horizons

O- Organic Horizons

- Organic Layers of Decaying Plant and Animal Tissue
- Aids Soil Structural Development
- Helps to Retain Moisture
- Enriches Soil with Nutrients
- Infiltration Capacity function of Organic Decomposition
- Organic Matter Critical in Maintaining Water Stable Peds

Dark in Color Because of Humus Material - 1,000,000 bacteria per cm³
Soil Horizons

A Horizons: “Topsoil”

- Mineral Horizon Near Surface
- Eluviation Process Removes Humic and Minerals from O Horizon into A horizon

Subordinates
- Ap - Plowed A Horizon
- Ab - Buried Horizon

- Soil dark in color, coarser in texture, and high porosity
Soil Horizons: B Horizons
Zone of Maximum Accumulation

- Mineral Horizon
- Illuviation is Occurring - Movement into the Horizon
- B Horizon Receives or Accumulates Organic and Inorganic Materials from Upper Horizons.
- Color Influence by Organic, Iron, Aluminum, and Carbonates Subordinantes
  - Bw - Weakly Colored or Structured
  - Bhs- Accumulation of illuvial organic material and sesquioxides
  - Bs- Accumulation of sesquioxides
  - Bt- Translocation of silicate clay
  - Bx- Fragipan Horizon, brittle
C- Horizons
Distinguished by Color, Structure, and Deposition

- Mineral Horizon or Layer, excluding Rock
- Little or No Soil-Forming
- May be Similar to Overlying Formation
- May be Called Parent Material
- Layer can be Gleyed (Redoximorphic Feature)
- Developed in Place or Deposited
- May be Weathered Parent Material
R- Horizons

- Hard, Consolidated Bedrock (Lithic Material)
- Typically Underlies a C Horizon, but could be directly below an A or B Horizon.
Where is the Color?

- Think of the soil ped as an M&M. An M&M has a hard outer shell and then a chocolate center.

- Ok – Well the uncoated soil separates (sand, silt, and clay) are gray and the minerals (Fe, Mn, Silicates, Carbonates, and Organics) create the outer shell or coating.

  Under Reducing Conditions

  Brown Soil Coating $\text{Fe}_2\text{O}_3$

  Fe+2 in Matrix, Less Fe+3

  Gray – Low Chroma Soil Iron Leached from Matrix
Reduced matrix

Does the soil have reduced Iron?

Add a,a’-dipyridyl dye – A red color – positive for reduced iron
What is the Soil Color? 10YR Page

10YR6/3 – pale brown
General Criteria for Hydric Soils

- Organic Soils
- Mineral Soils with High Water Table (permanent and seasonal)
- Ponded Soils
- Flooded Soils
Criteria 1 - All Histosols (Organic Soils)

- All Histosols, except Folists
- Contains 12-18% organic carbon by weight (saturated) or at least 20% organic carbon (unsaturated)
- 40 cm thick
- Includes:
  - Fibrists (fibric organic material)
  - Hemists (hemic organic material)
  - Saprists (sapric organic material)
Folists

- Are Histosols or organic soils that formed over shallow bedrock or fragmental material in cool, humid climates, that are saturated only for a few days after heavy rain.
- Primary Location – Hawaii and Alaska
Criteria 2- Saturation

• Somewhat poorly drained with a water table equal to 0.0 ft from surface during the growing season, or.
Criteria 2- Saturation- Part I

• Poorly drained to very poorly drained and have either:
  
  – Water table equal to 0.0 ft during the growing season if textures are coarse sand, sand, or fine sand in layers with 20 inches, or
Criteria 2- Saturation- Part II

• Poorly drained to very poorly drained and have either:
  – 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 in/hr in all layers within 20 inches, or
Criteria 2- Saturation – Part III

Poorly drained to very poorly drained and have either:

- Water table at less than or equal to 1.0 ft from the surface during the growing season if permeability is less than 6 in/hr in all layers within 20 inches, or
Criteria 3 - Ponding

- Soils that are frequently ponded for long or very long duration during the growing season
  - Frequently > 50 times in 100 years
  - Long duration is 7 to 30 days
  - Very long duration is > 30 days
  - Growing season – based on local soil temperature / moisture regimes
Criteria 4 - Flooding

- Soils that are frequently flooded for long or very long duration during the growing season
  - Frequently > 50 times in 100 years
  - Long duration is 7 to 30 days
  - Very long duration is > 30 days
  - Growing season – based on local soil temperature / moisture regimes
Soil Type

- Organic Soils
- Mineral Soils
Difference Between Organic and Mineral Soils

[Graph showing the difference in percent organic carbon and percent clay between organic and mineral soils.]
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