Our Valuable Soil Resources

National Park Service
U.S. Department of the Interior

Natural Resources Program Center
Geologic Resources Division

Soil is the unconsolidated portion of the earth's crust modified through physical, chemical, and biotic processes into a medium capable of supporting the growth of land plants. Soil extends from the earth's surface to the lower limit of biological activity. The soil volume includes a mineral fraction derived from geologic materials from the earth's crust; an organic fraction consisting of living, dead, and decomposing organisms and organic residues; and pore space containing air and water in varying percentages. Soil is three- dimensional, with layers (horizons) that vary in arrangement and thickness on different parts of the landscape. Soils are not static, but are in a dynamic equilibrium with the surrounding environment.

What does Soil do?

Soil plays a key role in many biological and physical processes. Soil is involved in nutrient cycling, the hydrologic cycle and energy capture and transfer. Its capacity to perform soil and ecological functions depends upon the condition of the soil resource. Soil functions include:

- Productivity
- Biodiversity
- Regulating water
- Storing, transforming and releasing nutrients
- Filtering and buffering contaminants
- Providing structural support

How is Soil linked to life, rocks, and the atmosphere?

The soil in our parks is a part of the global pedosphere, the envelope of the Earth where soils occur. It interacts with the atmosphere, hydrosphere, biosphere and lithosphere. Each ecosytem includes biological components and soil. The connections and interactions of these components are dynamic and are influenced by human activities.

How does soil change over time?

Five soil forming factors, e. g., climate, parent material, organisms, topography and time, determine the composition and morphology of soils (Jenny, 1941). Landuse history and increasing human influence in modern ecosystems can cause soil to change (Richter and Markowitz, 2001). "Every change in a system requires time, but change is not caused by the mere passing of time" (Nikiforoff, 1959). Change results from disturbances (natural and human) such as drought, floods, catastrophic fire and absence of fire, grazing, invasive plants, cultivation, improper land management, trails and roads.

What is soil change, and why is it important?

Soil change on the geologic time scale is part of natural processes just as plant succession after a fire allows the regeneration of forests. However, accelerated change, such as compaction or the loss of topsoil can cause degradation of soil resources and ecosystems. Understanding how soils change is important for many park management issues, including:

- Natural resources
- Wildlife habitat
- Cultural resources
- Threatened and endangered species
- Exotic species
- Roads and facilities
- Fire management
- Recreation and visitor management
- Soil, water and air quality

How is soil change evaluated?

Indicators are used to evaluate and detect changes in soil, ecological processes and functions. The capacity of the soil to perform its functions is called soil quality. For example, catastrophic fire, a disturbance in the forest ecosystem, produces a hydrophobic soil layer that can be detected using a water drop test. If the water drop forms a bead and does not enter the soil layer in a few seconds, this indicates that water regulation functions of the soil have changed. The hydrophobic layer will restrict infiltration and cause increased runoff that can result in erosion and downstream sediment deposition.

Do Soils resist change after a disturbance?

The intensity, frequency and timing of the disturbance determine its severity. Some soils can resist change after a minor disturbance, but not after a major one. Other soils can resist change even after major disturbances and still others cannot resist a minor disturbance. The interaction of two different disturbances, such as drought and catastrophic fire, often severely impact the soil's capacity to function.

What is resilience?

The ability of a soil to recover its capacity to function after a disturbance is called resilience. We know very little about soil recoverability, and yet it is crucial for many resource management decisions related to restoration and remediation. As a general rule, the more arid the system, the lower its resilience. For example, loss of the topsoil layer in a desert grassland is more limiting to grassland restoration than it is in a tallgrass prairie. Soil - plant interactions are sensitive to vegetation shifts. Consult local records of vegetation dynamics to develop hypothesis about soil recoverability.

Management Strategies

The NPS will actively seek to understand and preserve the soil resources of parks and to prevent, to the extent possible, the unnatural erosion, disturbance, physical removal, or contamination of the soil, or its contamination of other resources.

Integrated planning and management strategies for parks should include the soil resource. Typical steps include:

- Define goals for maintaining or enhancing soil quality.
- Inventory the soil's potential (information is in most soil surveys).
- Evaluate the current condition through soil quality assessment procedures.
- Include soil quality in monitoring schemes. Adapt management strategies based on monitoring results.

For More Information

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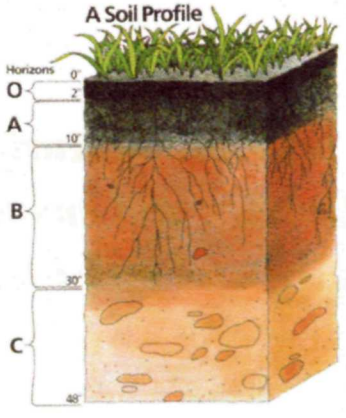
More information can also be found on the Soils website at: www2.nature.nps.gov/geology/soils

The National Park Service, Soil Inventory and Monitoring Program is partnering with the USDA-Natural Resources Conservation Service, and the USDA Agricultural Research Service, Jornada Experimental Range, to develop a series of assessment and monitoring protocols to assist NPS Vital Signs Monitoring Networks in understanding and evaluating the important role soils play within ecosystems.

What is Soil?

A NPS Definition of Soil;

The unconsolidated portion of the earth's surface modified through physical, chemical, and biotic processes into a medium capable of supporting the growth of plants. Soil extends from the earth's surface to the lower limit of biological activity. The soil volume includes a mineral fraction derived from parent materials from a variety of geologic sources; an organic fraction consisting of living, dead, and decomposing organisms and organic residues; and pore space containing air and water in varying percentages. Soil is three-dimensional, with layers (horizons) that vary in arrangement and thickness on different parts of the landscape. Soils are not static, but are in a dynamic equilibrium with the surrounding environment (From NPS-77, Soil Resources Management)



NPS Soil Resource Management Program Objectives

1. *Preserve intact, functioning, natural systems by preserving native soils and the processes of soil genesis in a condition undisturbed by humans to the extent possible*

2. *Maintain significant cultural objects and scenes by conserving soils consistent with maintenance of the associated historic practices, and by minimizing soil erosion to the extent possible*

3. *Protect property and provide safety to ensure that developments and their management take into account soil limitations, behavior, and hazards*

4. *Minimize soil loss and disturbance caused by special use activities and ensure that soils retain their productivity and potential for reclamation*