Rangeland Soil Quality

National Park Service
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Natural Resources Program Center
Geologic Resources Division

Wind Erosion

Wind erosion is the physical wearing of the earth's surface by wind. Wind erosion removes and redistributes soil. Small blowout areas may be associated with adjacent areas of deposition at the base of plants or behind obstacles, such as rocks, shrubs, fence rows, and roadbanks. In many cases the fine soil particles and organic matter are blown offsite or into the atmosphere as dust. Reducing the amount of bare ground by increasing the extent of vegetation, litter, and biological crusts reduces the risk of wind erosion.

Why is erosion a concern?

Loss of topsoil changes the capacity of the soil to function and restricts its ability to sustain future uses. Erosion removes topsoil, the layer of soil with the greatest amount of organic matter, biological activity, and nutrients, creating a less favorable environment for plant growth. Erosion breaks down soil structure, exposing organic matter within soil aggregates to decomposition and loss. Degraded soil structure reduces the rate of water infiltration. Erosion of nutrient- rich topsoil can cause or accelerate a shift to less desirable plants, such as from grass to shrub species. In this process, soil organic matter and nutrients eroded from one area contribute to resource accumulation in another, such as the area around shrubs. Erosion decreases soil depth and therefore the amount of air, water, and nutrients available for plant growth. This decrease can have a greater impact on shallow soils than on other soils. Windblown dust affects animal and human health, creates public safety hazards, and degrades air quality. Deposits of windblown soil can bury plants and fences and obstruct roadways.

What causes wind erosion?

Wind erosion can occur only when windspeed at the soil surface is sufficient to lift and transport soil particles. Moist soils and soils with stable aggregates or rock fragments are less likely to be eroded than other soils. Thick lichen crusts provide greater resistance to erosion than thin crusts. Sand moving across the soil surface wears away soil aggregates and thin crusts, causing more soil particles to become detached and to be blown away. A cover of plants disrupts the force of the wind. Soils are more susceptible to wind erosion where disturbance exposes individual particles and soil aggregates to the wind. When physical or biological crusts are crushed or broken apart by such disturbances as heavy grazing, vehicle or foot traffic, and water erosion, particle movement begins at the lower windspeeds. The following conditions increase the susceptibility of the soil to wind erosion:

- crushed or broken soil surface crusts during windy periods;
- a reduction in the plant cover, biological crusts, and litter, resulting in bare soil;
- a decrease in the amount of organic matter in the soil, causing decreased aggregate stability; and
- long, unsheltered, smooth soil surfaces.

What are some indicators of wind erosion?

Erosion and the risk of erosion are difficult to measure directly. Other soil properties that affect erosion and can change with management, including soil surface stability, aggregate stability, and content of organic matter, can be measured. Measuring these properties can shed light on the susceptibility of a site to erosion. Comparing visual observations along with quantitative measurements to the conditions in the ecological site description or a reference area helps to provide information about soil surface stability and wind erosion. The visual indicators used to identify past erosion include:

- bare soil,
- wind- scoured areas between plants,
- a drifted or rippled soil surface,
- loose sand on physical crusts,
- biological crusts buried by soil,
- pedestaled plants or rocks,
- exposed roots,
- soil deposition on the leeward side of plants and obstacles,
- litter movement to the leeward side of plants and
- obstacles,
- exposure of subsoil at the surface,
- reduced plant growth, and
- dust clouds.

When measured over time, the following indicators can be used to predict where accelerated erosion is likely to occur in the future:

- an increase in the amount of bare ground or in the size of bare patches,
- reduced soil surface stability, and
- a reduction in the amount of organic matter.

Management strategies that minimize wind erosion

The risk of erosion and the potential for recovery after erosion must be considered in any management plan. Disturbances, such as heavy grazing, fire that removes too much plant cover and litter, or vehicle and foot traffic, can increase the risk of wind erosion. Physical crusts protect the soil from wind erosion but can retard plant establishment. Areas with fertile topsoil are most likely to recover after a disturbance. Where much of the topsoil is lost, the site may no longer be able to support the historic vegetation. Management strategies include:

- Maintain or increase the protective cover of plants and litter on the soil through the application of good rangeland management practices.
- Reduce disturbances of physical and biological crusts, especially in arid areas.
- Maintain soil aggregate stability by improving or maintaining the quality of the plant community.

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.