Healthy Forest Understory Vegetation and Soil:

A Guide for Soil Conservationists and Small Forest Managers

WEST MULTNOMAH
Soil & Water Conservation District

With funding provided by

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

A dense Douglas-fir canopy in need of thinning hinders understory growth.

Healthy soil contributes to a healthy, diverse understory.

Foresters and private woodland owners, and the scientists and conservationists that support them, have an interest in what is growing on the forest floor.

A healthy understory can offer:

- Flowers for native pollinators
- Food for wildlife
- Resiliency against invasion by forest weeds
- Organic material to build healthier soil
- Stable soil that doesn't erode into nearby streams
- Beautiful views while recreating in the forest

Healthy soils that are rich in nutrients and organic matter better support native grasses and forbs.

In turn, a vibrant forest understory replenishes the soil with valuable nutrients each growing season, completing a cycle of soil health and diverse forest habitat.

Woodland owners often have ambitious goals for their land with hopes of growing a healthy forest with high quality wildlife habitat. When forming a management plan, it's important to assess current conditions and take note of any limitations or variables that might impact the outcome of a plan. This includes examining the soil in the forest. General observations of the soil will inform which strategies are best for enhancing understory vegetation.

Forest understory seeding study

Between 2018 and 2020, the West Multnomah Soil & Water Conservation District (WMSWCD) ran a study of seeding understory vegetation on eight forested properties in the Tualatin River Watershed which included soil research to learn what impact soil condition might have on seedling success.

Findings from this study inform the recommendations in this document. Contact WMSWCD at info@wmswcd.org for the full study report.

About the study sites:

Five properties had a forest floor with abundant native and non-native vegetation. Three properties had a much simpler understory largely bare of vegetation. These three latter properties were Douglas-fir plantations with very little diversity, and soils sampled here ranked near the bottom for organic matter, carbon, nitrogen, and active carbon. Researchers also observed that seeded plots appeared to grow with less vigor on these sites.

This finding may suggest that consistent input of Douglas-fir needles over time does not provide as much organic matter, carbon, nitrogen, and active carbon in the soil as a forest with deciduous leaf input from the understory, shrub layer, and diverse overstory.

A plot before and after raking.

Raking impact on soil and seeding:

The study team tested seeding plots they had raked down to bare soil as well as plots they had not raked. They discovered the raked plots grew much better than the unraked.

In conjunction, the team studied the soil before raking, at 1 year after raking, and again at 2 years after raking. Soil samples from the unraked plots were consistently higher than the raked plots in phosphorus, potassium, calcium, magnesium, and cation exchange capacity (CEC) across all years. This finding suggests that raking plots has a measurable negative impact on these nutrients and processes in the soil. The team also found that higher levels of organic matter on a site showed higher levels of carbon, nitrogen, and active carbon. When CEC was higher, those soils also had more potassium, calcium, and magnesium which are important cations in the soil.

The study team's final conclusion is that raking several small patches in an acre will help seedlings get established, but best practice is to leave most of the organic layer intact. If the seeding is successful, it is likely to spread through the forest over time.

Soil samples were collected from 46 total plots in each year of the study. In 2018, plot samples were combined into one sample from each site, while in 2019 and 2020, soil samples were combined from plots of the same treatment (1. raked, seeded; 2. raked, unseeded; 3. unraked, seeded). Samples were analyzed by Oregon State University Central Analytical Laboratory for the following variables: sand, silt and clay composition; water stable aggregates; volumetric moisture; carbon, nitrogen and organic matter composition; active carbon; CO2 respiration; potentially mineralizable nitrogen; pH; electrical conductivity; and concentration of phosphorous, potassium, calcium, magnesium, and cation exchange capacity. Three years of soils data were analyzed by Bio Lab Analytics, LLC.

Common soil conditions and recommendations

Erosion – Erosion is common near roads and streams. In these areas, seeding can be very helpful, but keep in mind that seeds can be easily washed away until slopes are stabilized. It's advisable to use a low-cost, shade-tolerant native grass seed mix to stabilize the area until the erosion decreases. Shrubs can also be great at stabilizing eroding slopes.

Seeding a slope like this with shade tolerant native grass could help slow erosion.

Bare ground – Sometimes the forest floor has nothing, or very little, growing on it besides the trees. This may be attributed to shade from a conifer forest, but it's also possible the soil is deficient in several nutrients normally present in an older forest. Check for compaction. If it seems very difficult to drive a shovel into the ground throughout the entire year, the soil may have become compacted by livestock or farming in the past. On these sites, plant a shade tolerant grass to start building organic matter that will later support more biodiversity.

A raked plot prepared for seeding. Plots should remain small to lose fewer nutrients.

Clearing organic matter – Clearing (or raking) organic matter such as maple or alder leaves to prepare for seeding has negative impacts on soil that can be detected within the first year after clearing, since this material adds nutrients to the soil as it breaks down. Yet, the clearing of leaves and other organic matter is essential to make sure the seeds make contact with the soil. When seeding in the forest, make a few small clearings for seed rather than clearing large areas. If the seeding is successful, it's likely to spread through the forest over time.

High levels of organic matter and nutrients support impressive growth in a seeded plot.

Building organic matter for healthy soil – Soils are created and shaped by complex interactions between geology, weather, topography, microbial activity, and land management. Some soil characteristics won't change significantly from land management practices. However, in the forests of northwest Oregon, managing organic matter is an effective way to improve soil conditions. Organic matter is very important to soil health. High levels of organic matter result in high levels of carbon, nitrogen, active carbon, and cation exchange capacity – all necessary for healthy soil. To improve or maintain organic matter in your forest, avoid disrupting leaf litter that accumulates, instead allow it to decompose and integrate into the soil. Growing diverse forests will allow many different nutrients to infiltrate the soil, perpetuating the cycle of healthy soil and healthy vegetation.

Lower levels of organic matter and nutrients in a seeded plot show less vigorous growth.

Why are these components important in forest soil…

Active carbon is the organic matter that feeds the soil microbial communities that provide nutrients to trees. Higher levels of organic matter will increase active carbon and will lead to more productive soils over time.

Soil organic matter is an important source of nutrients for forest vegetation. It increases nutrient exchange, retains moisture, reduces compaction, and increases water infiltration into soil.

Phosphorus is critical in the process of photosynthesis, which gives the trees and shrubs energy to grow.

Nitrogen is needed to build amino acids – the building blocks of proteins – which plant cells need to grow. Without adequate nitrogen, plants tend to turn yellow and produce less foliage and smaller fruits and flowers.

Calcium holds together the cell walls in plants. When plants lack calcium, they may show distorted growth.

Magnesium is the core of the chlorophyll molecule which helps absorb light for photosynthesis – the process of turning sunlight into energy for plant growth.

Cation Exchange Capacity (CEC) is the ability for a soil to hold cations which are positively charged ions. A soil with a high CEC will better hold Calcium, Magnesium, and Potassium for plant uptake.

For more information about understory forest vegetation and soil, contact:

Michael Ahr, Forest Conservationist
michael@wmswcd.org, 503.238.4775 x 109

Laura Taylor, Conservationist & Education Coordinator
laura@wmswcd.org, 503.238.4775 x 112