



Forest Service
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Rocky Mountain Research Station Science You Can Use *(in 5 minutes)*

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Timber and Tracks: Practices for Limiting Soil Disturbance During Harvest Operation

Timber harvesting can negatively impact soil health required for sustained forest production. Limiting the degree, extent, and distribution of soil disturbance during harvest operations will help continue the production of ecosystem services and goods from national forests. To help achieve this goal, RMRS research soil scientist Debbie Page-Dumroese and colleagues authored a report (RMRS-GTR-421) titled “Soil Sustainability and Harvest Operation: A Review.” This new resource highlights the science on long-term soil recovery after timber harvests and reviews types of impacts, effects of different harvest operation methods, and recovery times.

The impacts of timber harvesting are site-specific, and the guide covers how soil properties, such as particle size distribution and structure, both influence and are affected by disturbance from timber harvesting. It also covers how to measure the post-harvest soil disturbance. But, ideally, soil properties are measured throughout the timber harvesting activity. Page-Dumroese points out, “Soil disturbance monitoring is the best way to understand pre-harvest soil conditions and to relate that information to post-harvest effects and recovery and determine whether restoration is needed.”

The main types of soil disturbance from timber operations are compaction, soil displacement and erosion, and rutting and puddling on the soil surface resulting from traffic. According to Page-Dumroese, “Soil compaction from skid trails and log landings is often what people see and want to address when they go into a harvest unit, but these may not be the biggest impacts. Long-term research shows us the importance of maintaining soil cover by keeping the surface organic horizons intact during harvest operations.” Intact surface organic horizons support chemical, biological, and physical processes in the underlying mineral soil and also prevent erosion from wind or water.



Rutting on the Malheur National Forest, Oregon. Excessive traffic can cause rutting, particularly on skid trails that lead to a log landing and when slopes are greater than 20 percent. USDA Forest Service photo by Leslee J. Crawford.



Along with soil and site characteristics, the particular harvesting system used for logging affects the extent of the soil disturbance. Mechanized, ground-based harvest systems have the largest disturbance effect on soil compared to skyline, helicopter, or tethered operations. The GTR discusses the lesser impact of the cut-to-length systems on soils compared to whole tree removal, mainly because logging residues are distributed during the harvest and the resulting slash mats can act as a cushion to keep equipment from severely impacting the soil. Limiting the number of machine passes on a skid trail is also important, as most of the compaction occurs within the first 10 passes. New harvest methods, such as tethered logging on steep slopes, are opportunities to limit soil impacts and still harvest timber.

PROJECT LEAD

[Debbie Dumroese-Page](#) is a Senior Scientist and Research Soil Scientist at RMRS. Her research interests center around maintaining soil productivity during and after land management activities and improving soil health.



Erosion on a skid trail during salvage logging after the Canyon Creek Complex fire on the Malheur National Forest, Oregon. USDA Forest Service photo by Leslee J. Crawford.

KEY MANAGEMENT CONSIDERATIONS

- A new GTR reviews timber harvest operations and their effects on soil sustainability to help forest managers understand and limit impacts and allow national forests to continue to produce ecosystem services and goods.
- The main types of soil disturbance from timber operations are compaction, soil displacement and erosion, and rutting and puddling on the soil surface resulting from traffic. Some of these impacts may be severe enough to require restoration.
- Soil disturbance monitoring is the best way to understand pre-harvest soil conditions and relate that data to post-harvest effects and recovery to determine if restoration is needed.
- The harvesting system used for logging affects the extent of the soil disturbance, with ground operations having the largest impacts. Cut-to-length systems that distribute logging residues as slash mats across a site can serve as a cushion to keep equipment from severely impacting the soil.

FURTHER READING

Crawford, L.J.; Heinse, R.; Kimsey, M.J.; Page-Dumroese, D.S. 2021. [Soil sustainability and harvest operations: A review](#). Gen. Tech. Rep. RMRS-GTR-421. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 39 p.

Bergstrom R.M.; Page-Dumroese, D.S. 2019. [Do southern pine beetle suppression activities result in unusual amounts of soil disturbance?](#) Gen. Tech. Rep. RMRS-GTR-399. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 11 p.

Hwang, K.; Han, H-S.; Marshall, S.E.; Page-Dumroese, D.S. 2020. [Soil compaction from cut-to-length thinning operations in young redwood forests in northern California](#). Canadian Journal of Forest Research. 50: 185–192.

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