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USDOI Office of Surface Mining Reclamation and Enforcement

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INFLUENCE OF PLANT COMMUNITY STRUCTURE AND TOPSOIL HANDLING METHOD ON SOIL STRUCTURE DEVELOPMENT AND MICROBIAL COMMUNITY RECOVERY IN RECLAIMED SOIL.

Peter D. Stahl, L.J. Ingram, and A.F. Wick
University of Wyoming
Department of Renewable Resources

Project Description and Objectives:

The goal of this project was to determine the influence of topsoil handling practice and plant community type on soil structure redevelopment and microbial community recovery (including recovery of mycorrhizal fungi) on surface mine reclamation sites. Results of this work provide surface mine reclamationists with information to help choose seed mixes and soil handling strategies that result in reclamation of high quality soils.

Applicability to Mining and Reclamation:

Information gained through this project facilitates reclamation science by revealing soil and vegetation management practices that reduce nutrient, carbon and soil organic matter loss and increase soil stability, water holding capacity, porosity, and nutrient holding capacity. Revegetation of reclaimed soils in semiarid western regions with mixed grass and shrub communities promotes soil aggregation, carbon accumulation, and microbial community recovery. Overall, soil handling and revegetation technology recommended by this project will promote soil quality, carbon sequestration and ecosystem recovery. Results of this work can be applied throughout the western coal mining region.

Methodology:

Our general approach to this project was to examine and compare soil structural properties and soil microbial communities at sites reclaimed using either directly hauled topsoil or stockpiled topsoil and revegetated with either cool season grasses or sagebrush and cool season grasses.

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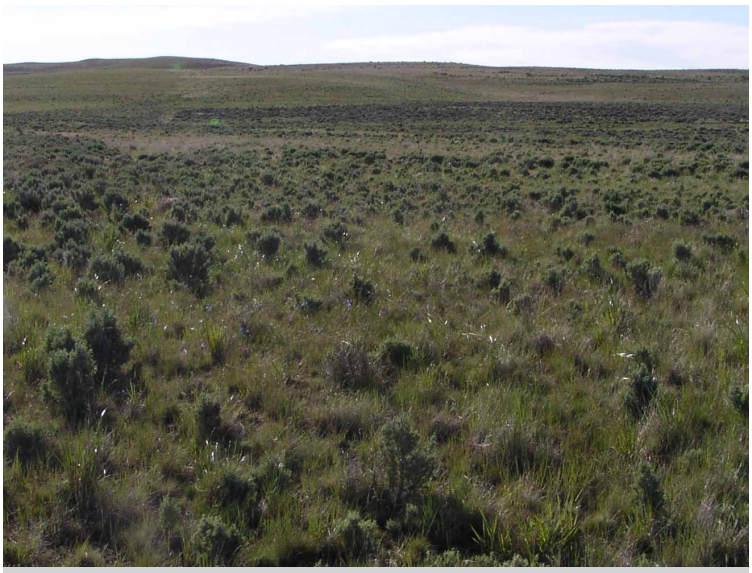
ABOVE PHOTO: Dr. Abbey Wick (right) and technician Kelli Sutphin (left) look over an area reclaimed with cool season grasses and shrubs while laying out sampling a sampling transect. Photo Credit: Lachlan Ingram.



ABOVE PHOTO: A well established cool season grass/shrub community. This area used to be an open coal pit. Photo Credit: Abbey Wick.

Methodology (continued):

Reclaimed sites included had different amounts of time to recover from disturbance associated with surface mining. We used established chronosequences of reclaimed sites on two mines in northeastern Wyoming (Powder River Basin).

Examination of soils recovering from disturbance for different amounts of time enabled us to track the process of soil structure redevelopment and microbial community recovery through time and compare how it differs at sites reclaimed with different plant communities and using different topsoil handling strategies. A greenhouse study was conducted to closely examine the influence of different plant species on soil aggregation and microbial community structure.

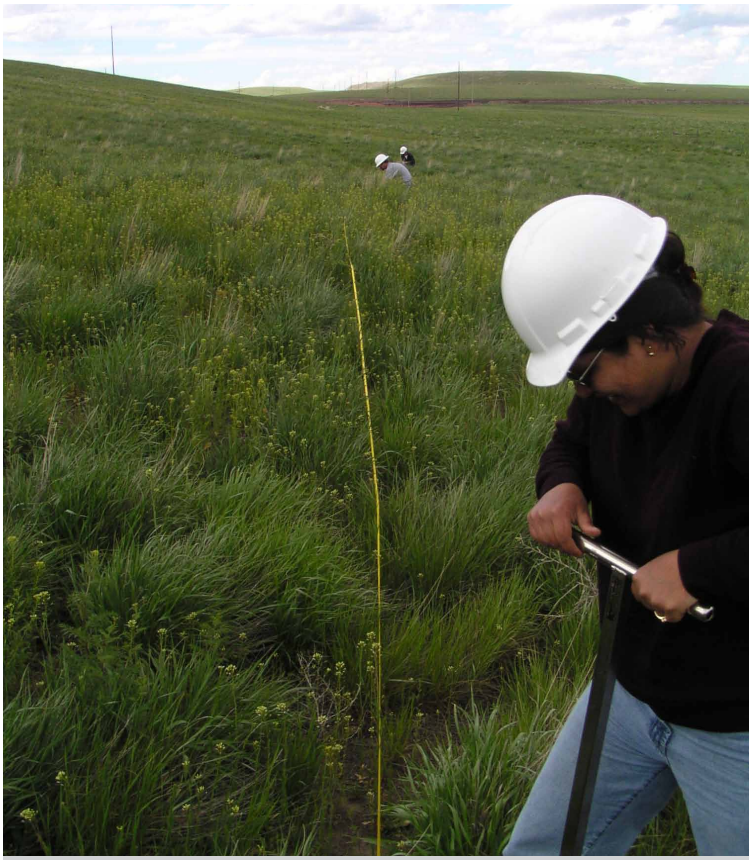
Highlights:

In directly hauled reclaimed soils, new C from C3 plant material contributed 59% of total C in the whole soil during the 26 years following reclamation, with 42% of new C contributions after 14 years since reclamation. Incorporation of new C was even more pronounced in the aggregate size fractions. Macroaggregate associated new C was 44% of total organic C within 14 years and increased to 66% after 26 years. Microaggregate new C increased from 62% of total organic C between the <1 year old site and 14 year old reclamation to 65% after 26 years.

There was a general increase in all microbial groups in stockpiled soil before being respread and reseeded. There were, however, two exceptions to this general phenomena, Actinomycetes and 'total' microbial biomass. In both cases, there was a very rapid increase with five years for both actinomycetes and 'total' biomass relative to the newly reseeded site.

Results/Findings:

This project generally indicates that directly hauled topsoil recovers from disturbance more rapidly than stockpiled topsoil in terms of carbon accumulation, soil aggregate structure, microbial community structure and general soil quality. As reclaimed soils age, however, especially 15 years or more after reclamation, it is difficult to find significant differences between soils that were directly hauled and those that were stockpiled. This is also true of the influence of the plant community type reestablished on reclaimed soils. Reclaimed soils on which mixed grass and shrub communities were established recovered more quickly than those on which cool season grasses were established in terms of soil structure, carbon accumulation and microbial community structure. Again, however, after 15 or more years of reclamation differences in soils under the two vegetation types were difficult to distinguish.



Above Photo: Soil sampling on one of the cool season grass sites conduted by Sadikshya Rana. Photo Credit: Abbey Wick.

Website Information:

The final project report can be found at **http://www.techtransfer.osmre.gov/NTTMainSite/appliedscience/2006appscience/CompletedProjects/UWYOInfluenceofPlant2006.pdf**

Principal Investigator:

Dr. Peter D. Stahl
University of Wyoming
Department of Renewable Resources
(307) 745-9039
unclem@uwyo.edu

OSM Project Technical Representative:

Duane O. Matt
(303) 293-5072
dmatt@osmre.gov

For Further Information About OSM's Applied Science Programs:

Kimery Vories - kvories@osmre.gov - (618) 463-6463, Ext. 5103