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Journal of the American Society of Mining and Reclamation

The Journal of the American Society of Mining and Reclamation **(JASMR)** promotes the exchange of basic and applied solutions for the reclamation, restoration, and revitalization of landscapes impacted by the extraction of natural resources—including, but not limited to coal, minerals, gas, and oil. Contributions reporting original research, case studies, field demonstrations, or policy dealing with some aspect of ecosystem reclamation are accepted from all disciplines for consideration by the editorial board.

Contributions to JASMR

The Journal of the American Society of Mining and Reclamation publishes contributions under the headings Research Papers, Case Studies, Demonstrations, Policy Papers and Review articles. All papers are peer reviewed. Manuscripts may be volunteered, invited, or coordinated as a symposium.

Research Papers: Emphasis is given to the understanding of underlying processes rather than to monitoring. Applying these principals to specific, replicated laboratory, glasshouse, and field problems dealing with reclamation are encouraged. These reports are grouped into the following ASMR defined groups: ecology, forestry and wildlife, geotechnical engineering, land use planning and design, international tailings reclamation, soils and overburden, and water management.

Case Studies: Papers in this category report on reclamation activities over spatial or temporal scales. Monitoring of the response of ecosystem components (water, soil, and vegetation) to innovative practices are the basis for these case study reports.

Demonstration Studies: Papers in this category report on reclamation activities that do not necessarily include projects where significant amounts of data are collected. These may consist of largely photographic evidence of before and after some reclamation technique is applied. These may be observations that practicing reclamationists have observed that have changed how they continued to enhance the process of returning disturbed landscapes to a more desirable condition.

Policy or Review Papers: Submission of papers dealing with regulatory and procedural issues are welcome. These papers emphasize changing approaches to the science and technology of landscape revitalization. We strive to have them reviewed within 6 weeks.

Other: Letters to the Editor are accepted, and Book Reviews may be invited by the Editor-in Chief.

Printed copies: Although this Journal is an online Journal, copies are available at the cost of printing with an ink-jet or color laser printer.

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Cover photo is curtesy of Mr. Richard Prodgers. Bighorn Environmental Sciences, Dillon, MT 59725

Manuscripts are submitted electronically to Dr. Richard Barnhisel at asmrjournal@twc.com or asmr@twc.com

Style Guide for Authors: Manuscript preparation guide is available at: http://www.asmr.us/Publications/Journal/Manuscript%20Guidelines%20Journal.pdf Which is preferred or https://www.soils.org/files/publications/style/chapter-01.pdf

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Research Papers

Abstract: One century after mine waste left 32 km-long Silver Bow Creek and its floodplain contaminated with acidic heavy metals, the State of Montana reclaimed it. While limited bird use occurred before remediation, large and varied populations quickly repopulated. Three of the most important habitats are open water, wetlands, and tall shrubs, but nearby habitats and land uses are also important. Migrations set the vernal monthly trends.

Bird data were summarized over 1.5 decades for four five-mile subareas, which are sets of habitats, not replicates. Sampling followed the Region 1 Forest Service monitoring procedure with fewer environmental descriptors. Twenty stations per subarea were sampled from March-June, which took about four hours per session starting just after dawn. Data analysis focused on bird abundance and diversity,

- March bird use is indicative of winter residents. Migratory birds swell the April census, which roughly doubles in May and June.
- Species compositions within subareas are weakly similar even for proximate years. This presages weak temporal trends.
- Birds quickly colonize fresh revegetation with no convincing trend in bird counting during the ensuing decade. Assigning birds to trophic levels likewise evidenced no decade-scale temporal trends.
- Analyzing bird use in the two main habitats, fluvial tall shrubs and wetlands, bird counts again revealed no temporal trends. In conjunction with low similarities, this indicates relatively steady abundance with variable composition.
- Species diversity (richness and evenness of relative abundance) increased over time beginning at about six years in wetlands and eight years in the fluvial-tall- shrub type. Time keys for vegetational development.
- While most species' needs can be met by numerous habitat combinations, habitat specialists demonstrate convincing temporal trends in relation to specific vegetational development. The willow flycatcher and marsh wren require mid-seral to mature vegetation. Spotted sandpipers decline as gravelly shorelines fill with plants.

Key Words*:* Restored bird habitats, temporal trends, species diversity, trophic levels, revegetation, vegetational development, habitat specialists.

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[1] Oral presentation at the 2019 National Meeting of the American Society of Mining and Reclamation, Big Sky, MT. Welcome back to Montana: The Land of Reclamation Pioneers, June 3-7, 2019. Published by ASMR, 1305 Weathervane Dr., Champaign, IL 61821.

[2] Richard A. Prodgers (presenter), plant ecologist, Bighorn Environmental Sciences, Dillon, MT 59725. Nate Kohler, ornithologist, Bighorn Environmental Sciences, Deer Lodge, MT 59722.

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http://www.asmr.us/Publications/Journal/Vol 8 Issue 2/Prodgers-MT.pdf

DOI: http://dx.doi.org/10.21000/JASMR19020001

USE OF POULTRY LITTER, SWINE MORTALITY COMPOST, AND FGD GYPSUM ON RECLAIMED LIGNITE MINE SOIL IN MISSISSIPPI[1]

J.J. Read[2*], A. Adeli, D.J. Lang, and N.R. McGrew

Abstract: Knowledge of soil and plant responses to animal or industrial byproducts is needed for effective use of these amendments on reclaimed mine soils. A 5-yr study (2011-2015) at a surface lignite mine in northeast Mississippi determined soil chemical, common bermudagrass, and loblolly pine responses to animal waste and flue gas desulfurization (FGD) gypsum. The study was a randomized complete block design with three replicates consisting of the annual application of 22.4 Mg ha^{-1} poultry litter, 22.4 Mg ha^{-1} swine mortality compost, and 896 kg ha^{-1} NPK fertilizer (13-13-13; the standard practice), with and without co-application of 11.2 Mg ha^{-1} FGD gypsum. Soil amendment treatments were incorporated to 15 cm depth in May 2011 and applied without incorporation in 2012-2015. Soil samples were collected each year at 0 to 15 cm and 15 to 30 cm depths. Analysis of surface 0 to 15 cm soil depth in December 2015 indicated greater pH, organic matter, and extractable P with poultry litter than NPK fertilizer; whereas, total CEC differed slightly ($P < 0.10$) between these treatments (22.9 vs. 20.2 cmol (+) kg^{-1}). The co-application of FGD gypsum with poultry litter, swine compost, and NPK fertilizer decreased organic matter of surface soil in December 2015 by approximately 33, 6, and 12%, respectively. In subsurface 15 to 30 cm soil depth, pH, organic matter, and available P and K levels did not differ among amendment treatments. Applying poultry litter in 2011 generally improved bermudagrass vigor and canopy height as the plants became established. Annual DM yield was affected by soil amendment, year, and their interaction and its ranking among fertility treatments in 2012-2014 was poultry litter > NPK fertilizer = swine compost. The height/diameter ratio of loblolly pine was least with poultry litter, suggesting these trees have improved stability. Repeatedly applying poultry litter improved soil fertility and plant growth parameters in a respread area.

Additional Key Words: bermudagrass, composted swine mortalities, fertilizer, land reclamation, manure, nitrogen, oxidized overburden, soil organic matter.

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[1] Poster paper presented at the 2018 National Meeting of the American Society of Mining and Reclamation, St. Louis, MO: **The Gateway to Land Reclamation**, June 3 - 7, 2018. Published by ASMR; 1305 Weathervane Dr., Champaign, IL 61821.

[2] John J. Read, Research Agronomist, USDA-ARS, Crop Science Research Laboratory, 810 Hwy 12 E, Mississippi State University, Mississippi State, MS 39762; Ardeshir Adeli, Research Soil Scientist, USDA-ARS, Crop Science Research Laboratory, 810 Hwy 12 E, Mississippi State University, Mississippi State, MS 39762; David J. Lang, Professor, Plant and Soil Sciences Department, Mississippi State University, Mississippi State, MS 39762; N. Rebecca McGrew, Environmental Manager, North American Coal Corporation, 5340 Legacy Dr # 300, Plano, TX 75024

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http://www.asmr.us/Publications/Journal/Vol 8 Issue 2/Read-MS.pdf

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Case Studies

VEGETATION FUNCTION AND DIVERSITY ON RECLAIMED SURFACE-MINED LANDS OF SOUTHEASTERN OHIO, USA[1]

Douglas J. Spieles[2], Emily Bennett, William Weems, and Rebecca Swab

Abstract. Surface coal mining has transformed certain regions of Appalachia. Reclamation laws have evolved over the past fifty years, creating spatiotemporal variability in reclaimed landscapes. While the vegetation composition of reclaimed lands is well understood, less is known about the associated development of ecological function. We used two attributes of the plant community—diversity and the capacity to absorb photosynthetically active radiation—as fundamental indicators of ecosystem composition and function. Using both satellite-derived light reflectance and field sampling, we characterized the successional trajectory of reclaimed lands, reference forest, and reference grasslands in southeastern Ohio, USA. We also assessed the importance of active management in ecosystem restoration. The reclaimed lands in this study represent four different eras of regulation, from pre-1972 to post-1981. We compared the Normalized Difference Vegetation Index (NDVI) within and among sites from 2000-2016, and the Shannon-Wiener diversity index among sites in 2016-2017. In this study, the oldest reclamation sites (45-50 years since reclamation) achieved the highest capacity for light absorption by 2016, suggesting that time since disturbance, reclamation technique, or a combination of the two are conducive to the restoration of ecological function. Younger reclaimed sites (25-35 years since reclamation) accrued function more rapidly than older sites—reaching NDVI equivalence with reference ecosystems 28-34 years after mining—suggesting that reclamation technique can accelerate recovery. Active management of reclaimed lands does not improve light absorption capacity, but it does increase plant diversity, which is linked to a variety of other ecological functions.

Additional Key Words: Appalachia, ecosystem restoration, remote sensing, NDVI

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[1] Paper submitted for consideration in JASMR and Published by ASMR; 1305 Weathervane Dr., Champaign, IL 61821.

[2] Douglas J. Spieles is Professor of Environmental Studies at the McPhail Center for Environmental Studies, Denison University, Granville, OH 43023; Emily Bennett and William Weems are Denison University students; Rebecca Swab is Director of Restoration Ecology at The Wilds, Cumberland, OH 43732.

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http://www.asmr.us/Publications/Journal/Vol 8 Issue 2/Spieles-OH.pdf

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ABOUT THE AUTHORS

Ardeshir Adeli is a Research Soil Scientist determining the impact of animal and industrial by-products on soil microbial ecology and activity to better understand factors controlling soil nutrient and biological properties and their relationship to crop yield in both agricultural and reclaimed coal mine soils. His research involves use of cover crop and crop rotations that reduce soil P build up when fertilized with poultry manure, use of P and N immobilizing agents (e.g., FGD gypsum, lignite and biochar) that mitigate P loss in runoff and N loss via ammonia volatilization and/or leaching, and use of poultry manure application type, rate/or and timing that conserves manure nutrients for crop production and improves soil chemical, physical and hydrological properties.

Em Bennett is a senior at Denison University, graduating in the spring of 2019 with a double major in Environmental Studies and International Studies. Her research includes her summer research experience focusing on strip mining legislation effects in Southeastern Ohio, and her Senior Research focusing on the multifaceted tourist industry alongside the Korean Demilitarized Zone. She has a wide range of interests such as Environmental Justice, Diplomacy with the Korean Peninsula, and Global Environmental Policy and Movements.

Nate Kohler is an accomplished ornithologist and odonatologist in Montana, leading field trips and monitoring birds for remediation projects.

David J. Lang is a Professor of Agronomy at Mississippi State University who specializes in forage and pasture crops including their establishment on drastically disturbed reclaimed lignite mine land. He has published nearly 200 papers in journal articles or conference proceedings. Dr. Lang has won national Office of Surface Mining (OSM) awards for his mine reclamation work and has been named as a national Merit Award from the American Forage and Grassland Council.

N. Rebecca McGrew is the Manager, Regulatory and Environmental Affairs for North American Coal Company. Ms. McGrew graduated with an undergraduate and Masters degree in Geosciences from Mississippi State University. Early in her career, Ms. McGrew worked offshore as a Quality Control Geophysicist and then spent six years as an environmental consultant specializing in contaminant fate and transport. She has been with North American Coal for 11 years and has spent her career focused on fostering and maintaining a culture of environmental excellence.
Photo was not available.

Rich Prodgers has worked on reclamation and monitored Montana revegetation for forty years, sometimes delving into soils and even birds.

John J. Read is a Research Agronomist determining the nutrient contents of crops and soils fertilized with manure. His research supports the development of alternative and effective best management practices for the farmer, including application rate/timing, species/variety selection and precision agriculture technologies. His research accomplishments have been primarily in crop physiology, physiological ecology and plant nutrition, especially the responses of cotton and grasslands to nitrogen and manure fertilization. From 2011 to 2017, Dr. Read planned and conducted team research in cooperation with Mississippi Lignite Mining Company, Ackerman, MS. The team presented papers at 29th, 31st, 32nd, and 35th Annual Conferences of the American Society of Mining and Reclamation and published findings in *Soil Science, Agronomy Journal, and Journal of Environmental Quality.*

Douglas Spieles is Professor and Director of the Environmental Studies Program at Denison University in Granville, Ohio. He earned a Ph.D. from the Ohio State University in Environmental Science. At Denison, he teaches courses on Ecosystem Management, Wetland Ecology and Geographic Information Systems. His recent publications include two books, Protected Land: Disturbance, Stress and American Ecosystem Management (Springer, 2010) and Environmentalism: An Evolutionary Approach (Routledge, 2017).

Rebecca Swab has been Director of Restoration Ecology at The Wilds since 2015. An Ohio native, Rebecca attended the Ohio State University where she received combined bachelors and masters degrees. She went on to complete her Ph.D. at the University of California Riverside, where she studied how plants respond to stressors such as changing fire intervals and climate change.

As director of restoration ecology, Rebecca's goal is to serve as a bridge between conservation managers and researchers. She couples restoration projects on reclaimed mine lands with research to determine which restoration methods work best. Information about which methods and projects are the most successful at reaching goals such as increasing native species diversity and ecosystem function are then shared with the larger conservation community to improve the field of restoration ecology.

William Weems is a senior Environmental Studies major at Denison University with a concentration in Dispute Resolution. He spent the last summer working with Friends of Deckers Creek, a non-profit working to restore a watershed that has been heavily affected by coal mining in West Virginia. If he's quite honest, he doesn't really know what the future holds for him, but he would like to work with communities, possibly with AmeriCorps. He's passionate about protecting and enjoying the outdoors, and helping others understand environmental issues.