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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.

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Table of Contents

Research Papers

To open the papers, click on the pdf file below the author's name.

Case Studies

Letter to the Editor

Dr. R.N. Humphries, Dorchester, UK Topic: **Reviews and Reviewers**

Click below to open letter.

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Abstracts Follow

ABSTRACTS OF PAPERS
RESEARCH PAPERS

METALS IN SOIL AND AMERICAN CHESTNUT TISSUE IN EXPERIMENTAL SOIL TREATMENTS PLOTS ON A COAL MINE RECLAIMED SITE [1]

J.M. Bauman[2], R. Brisbin, K. Gilland, and E.T. Cline

Abstract: The Appalachian Regional Reforestation Initiative outlines planting methods that include preparation of a deep-rooting zone for healthy tree establishment (> 1.3 m deep). Continued monitoring may show that soil-ripping has pronounced effects in later years. However, little is known about the interactions of reclamation methods, buried metals, and micronutrients in soils on reclaimed coal mined sites. This study examined soil samples and plant tissue in eight-year-old pure American (*Castanea dentata*) and hybrid chestnuts BC_1F_3, and BC_2F_3 (*C. dentata* × *C. mollissima*) on a reclaimed coal mine site located in Dresden, Ohio under various treatments: 1) untreated control plots, 2) plots plowed and disked to 30 cm depth, 3) plots deep-ripped to 1 m depth, and 4) combination of ripped and plowed/disked. Soil samples were collected in triplicate from all four treatments (n=3). Leaves were collected from a randomly selected subset of 108 trees (n=9). Flowers were collected from this subset (22 individuals), representing all treatments. Soil, leaves, and floral tissue were analyzed for silver (Ag), aluminum (Al), arsenic (As), cadmium (Cd), copper (Cu), manganese (Mn), lead (Pb), selenium (Se), and zinc (Zn) using inductively coupled plasma-mass spectrometry. No differences were detected when metal concentrations in soil, foliage, and floral tissue were compared among soil preparation treatments and chestnut tree types. Soil concentrations of Cu, Mn, and Se were detected at higher levels than county averages. Differences were noted when metal concentrations in soil were compared to chestnut leaves and chestnut floral tissue ($P < 0.05$). Elements including As and Cd were detected in soils but not found in tree tissue, indicating no potential transfer into the food chain. However, Se and Cu concentrations in chestnut floral tissue were significantly higher when compared to foliage ($P = 0.004$ and < 0.0001), which merits monitoring focused on metal concentrations in developing chestnut seeds.

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[1] Poster presented at the 2016 National Meeting of the American Society of Mining and Reclamation, Spokane, WA ***Reclaiming the West*** June 4-9, 2016. Published by ASMR; 1305 Weathervane Dr., Champaign, IL 61821.

[2] Jenise M. Bauman, Professor, Huxley College of the Environment, Western Washington University, Poulsbo, WA, 98370; Ryan Brisbin, Student, University of Washington, Tacoma, WA, 98402; Keith Gilland, Professor, University of Wisconsin-Stout, Menomonie, WI 54751; and Erica T. Cline, Professor, University of Washington, Tacoma, WA, 98402

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http://www.asmr.us/Publications/Journal/Vol_5 Issue 2/Bauman-WA.pdf

VEGETATIVE COMMUNITY DEVELOPMENT OVER 30 YEARS WITHIN MIXED PINE-HARDWOOD MINE RECLAMATION SITES IN EAST TEXAS

Christy L. Christian[1], Brian P. Oswald, Hans M. Williams, and Kenneth W. Farrish

Abstract. The practice of mine reclamation aims to balance the energy needs of society with proactive environmental restoration of degraded land, and long-term studies of vegetative community development on reclaimed mine land have been invaluable in developing effective reclamation practices. This study investigated vegetative community characteristics (composition, richness, species importance) over a 30-year time frame in planted mixed pine-hardwood areas on reclaimed surface coal mine land in East Texas, United States. Reclaimed sites were compared vegetatively to unmined reference forests. A chronological pattern was shown for reclaimed community development in both understory and overstory strata. Understory community development exhibited natural patterns, while the overstory community varied with different groups of planted species. The older reclaimed sites were most similar to unmined reference sites. Dissimilarities between mined and unmined communities were also apparent; for example, the woody vine community of reference sites was much more substantial in midstory and overstory strata as compared to reclaimed sites. Overall, this study provided baseline ecological information about these plant communities that may assist land managers and researchers in furthering their development of reclamation techniques and attainment of reclamation goals.

Additional Key Words: composition, importance, lignite coal, microtopography, richness, surface mining, succession, wildlife habitat

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SALIX SPP. AS A BIOMASS CROP: INVESTIGATING ITS POTENTIAL ON MINED LANDS AND THE USE OF BIOCHAR AS A SOIL AMENDMENT[1]

H.A. Nobert[2], D.W. McGill, S.T. Grushecky, J.G. Skousen, and J.L Schuler

Abstract: Rising energy demands and costs have increased the need to develop alternate sources and markets. Biomass plantations are proposed as part of the renewable energy solution. In West Virginia, over 50,000 acres of previously mined and reclaimed land are suitable for cultivation with bioenergy crops, including woody plants. The feasibility of growing shrub willow (*Salix* spp.) for the dual purpose of restoration and biomass crop production was assessed on reclaimed surface mines and fallow agricultural land in West Virginia. Replicated field trials were established and monitored over one growing season at four sites throughout the state. Within the field trials, biochar was tested as a soil amendment to mitigate soil quality issues associated with mine soils and fallow agricultural land. To characterize *Salix* spp. potential as a feedstock, proximate analysis, ultimate analysis, and heating value were measured. Wood properties for one-year-old material were compared with the specifications required for woody biomass combustion or ethanol production. Relative to these specifications, ash content was slightly higher (2.7% vs. 1.0%) as was nitrogen (0.98% vs. 0.35%), whereas volatile matter was lower (79.8% vs. 82.0%). Based on these standards, *Salix* spp. grown on reclaimed surface mines or fallow agricultural sites appears to be a suitable biomass feedstock for combustion and biofuel production. Biochar improved growth 80.7% and yield 72.4% compared to non-amended plots. Improved growth and yield in biochar-amended plots in the first year of growth gave willow saplings a competitive advantage over weeds. Additionally, biochar has shown long-term positive impacts in field studies, and improved growth and yield during the first year may prove to give higher yields in the long term.

Additional Key Words: mine reclamation, shrub willow, SRWC

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[1] This paper was presented as a poster paper at the 2016 National Meeting of the American Society of Mining and Reclamation, Spokane, WA ***Reclaiming the West*** June 4-9, 2016. R.I. Barnhisel (Ed.) Published by ASMR, 1305 Weathervane Drive, Champaign, IL 61821.

[2] Heather A. Nobert graduated from West Virginia University, Morgantown, WV 26505 with a Master of Science in Forestry in December 2015; Dave McGill is a Forest Resources Professor and Extension Specialist at West Virginia University; Shawn Grushecky is a Research Associate and Assistant Director of the Appalachian Hardwood Center in Morgantown, WV; Jeffrey Skousen is a Professor of Soil Science and Land Reclamation Extension Specialist at West Virginia University; and Jamie Schuler is an Assistant Professor of Silviculture at West Virginia University.

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NATURAL PROCESSES FOR THE RESTORATION OF DRASTICALLY DISTURBED SITES[1]

David F. Polster[2]

Abstract. Natural processes have been revegetating naturally disturbed sites (landslides, volcanic explosions, earthquakes, etc.) since the advent of terrestrial vegetation about 400 million years ago. Understanding the way these natural processes operate provides a framework for the design of restoration programs for anthropogenic disturbances (mines, industrial disturbances, etc.). The first step in the design of a natural process based restoration program is to identify what it is that is delaying the natural recovery from occurring (filters). Common abiotic stressors (filters) are adverse texture, nutrient status, adverse chemical properties, soil temperature extremes, compaction, adverse micro-site conditions, and excessive erosion. Biotic filters include herbivory, competition, propagule availability, phytotoxic exudates, facilitation, and adverse species interactions. Once the filters that are preventing recovery are identified and addressed, the natural processes will operate to restore the site. Care must be taken not to solve one problem by creating another. Traditional grass and legume seeding has been used to control erosion on many reclamation sites. However, the seeded cover has been found to restrict the growth of woody species so if a forest is what the restoration program is directed at, then seeding with grasses and legumes may be inconsistent with desired results. Making sites rough and loose can address a number of filters (compaction, excess erosion, lack of micro-sites, soil temperature extremes) and costs about a third of the cost of traditional hydroseeding. In many cases, there are ample seed sources nearby and making a mine site rough and loose with the application of large woody debris at a rate of 100 m^3/ha (determined from studies in Northern Alberta) can initiate the recovery process. Pioneering species often have effective seed dispersal mechanisms so creating the right habitat can result in the establishment of the pioneering species that are adapted to the local conditions. Practices such as making sites rough and loose (like trees in a forest turning up the soil) and scattering large woody debris on the area can initiate recovery on drastically disturbed sites.

By creating conditions (rough and loose with woody debris) that foster invasion by pioneering species as well as controlling erosion means that generally the need for seeding or planting is eliminated. Large bulldozers can be used to reslope waste dumps. The incorporation of wrap around dumps in mine design reduces the cost of resloping. Large excavators can be used to make the resloped waste dumps rough and loose and to scatter the woody debris. Using natural recovery processes reduces the costs associated with traditional restoration of large disturbances.

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[1] This paper was presented at the 2016 National Meeting of the American Society of Mining and Reclamation, Spokane, WA ***Reclaiming the West*** June 4-9, 2016. R.I. Barnhisel (Ed.) Published by ASMR, 1305 Weathervane Drive, Champaign, IL 61821.

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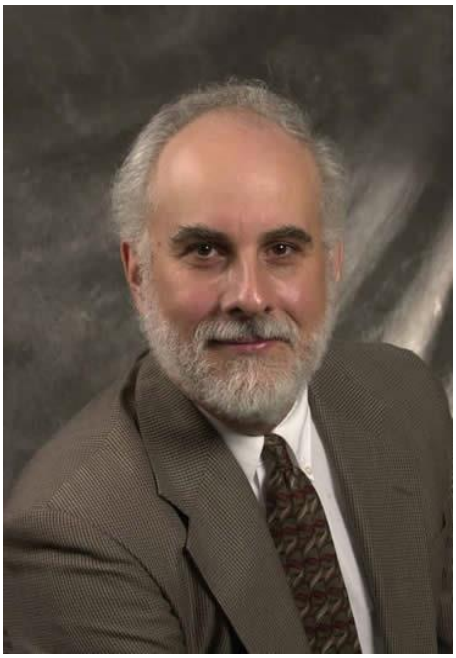
ABOUT THE AUTHORS

Dr. Jenise Bauman is a professor at Western Washington University in Huxley College of the Environment. She earned her Ph.D. from Miami University, Oxford Ohio, M.S. from West Virginia University, and B.S. at Eastern Kentucky University. Dr. Bauman is initiating projects that are focused on the restoration of coal mine landscapes in the Appalachian forests, the recovery of riparian forests in the Pacific Northwest, and the reconstruction of estuaries in urban areas of the Western Washington peninsulas. Her research couples field methods with molecular techniques to better understand vegetation establishment, plant interactions, and system recovery in disturbed soils. Research foci include belowground interactions of beneficial fungi during restoration, impact of invasive species on plant-fungal mutualisms, and plant pathology within forest restoration.

Ryan Brisbin is a research technician at the University of Washington in Tacoma. His research area applies inductively coupled plasma mass spectrometry and environmental DNA to ecological samples. He graduated in 2016 from the University of Washington, Tacoma with his BA in Criminal Justice. Ryan is currently applying for his PhD in the areas of biochemistry and molecular biology.

Mrs. Christy Christian received her B.S. in Environmental Science from Sweet Briar College in Virginia and worked four years as an environmental consultant in Texas before she began graduate school. She received her M.S. in Environmental Science from Stephen F. Austin State University, Nacogdoches, Texas, during which time she discovered her interest in plant community ecology. Her long-term plans include pursuing a Ph.D. and focusing her studies on the botanical sciences.

Dr. Erica Cline is a professor at the University of Washington Tacoma in the Division of Sciences and Mathematics in the School of Interdisciplinary Arts and Sciences. She earned her Ph.D. from the University of Washington College of Forest Resources, M.S. from the Rijks Universiteit Leiden, the Netherlands, and B.S. from the University of Puget Sound. She is a forest ecologist with interests in mycorrhizal fungi in forests and their role in restoration. She studies the role of mycorrhizal fungi in promoting reestablishment of conifer forests after severe anthropogenic and natural disturbance. Her active research projects also include metals contamination of forests and effects on forest health and impacts on mushroom foragers.



Dr. Kenneth W. Farrish is Director of the Division of Environmental Science at Stephen F. Austin State University and Arnold Distinguished Professor of Environmental Science and Forestry. He holds the PhD from the University of Minnesota, MS and BS degrees from Michigan Technological University, and is a SSSA Certified Professional Soil Scientist. His research interests are varied with previous and current work in remediation of contaminated soils, soil ecology, and soil health.

Dr. Keith Gilland is an assistant professor at the University of Wisconsin-Stout in Menomonie, WI. He earned his Ph.D. from Ohio University in Athen Ohio, and a B.S. in Botany at Miami University in Oxford Ohio. Dr. Gilland is currently working on projects involving the restoration of terrestrial habitats in West-Central Wisconsin, focusing in particular on riparian areas with the aim of reducing the phosphorous loading that results in harmful algal blooms in local water bodies. He is also active in ongoing research work involving American chestnut restoration in southeastern Ohio in a matrix of former white pine monoculture plantations.

Dr. Shawn T. Grushecky is the Coordinator for the West Virginia University Professional Land Management Program. He received his B.S. in Wildlife Resources, M.S. in Forest Resources Science, and Ph.D. in Forest Resources Science with an emphasis on Wood Science all from West Virginia University.

Dr. David W. McGill is Forest Resources Professor and Extension Specialist at West Virginia University. He received his B.S. in Natural Resources Management from California Polytechnic State University, his M.S. in Forestry from the University of Wisconsin, and his Ph.D. in Forest Resources from The Pennsylvania State University. His research interests include woodland owner outreach methods, cross-boundary cooperation, and forest regeneration.

Heather Nobert is the Forest Products Marketing Coordinator for the Nebraska Forest Service. She received her M.S. degree in forestry from West Virginia University in Morgantown, WV, and B.A. degree in biology from Albion College in Albion, MI.

Heather's primary professional interest is in the field of biochar. She has four years' experience with biochar in the United States and Peru, primarily in the fields of mine land reclamation and sustainable agriculture. In addition to soil health, she is also interested in the capacity of biochar to improve water quality and sequester carbon as a way to combat climate change.

Heather currently works with bioenergy systems and non-traditional wood products to promote sustainable forest management in Nebraska. Previously, she worked as a biochar research assistant in Peru and as an AmeriCorps volunteer.

Heather lives in Lincoln, Nebraska and enjoys travelling, cooking, and practicing yoga.

Dr. Brian P. Oswald is the Joe C. Denman Distinguished Professor of Forestry in the Arthur Temple College of Forestry and Agriculture at Stephen F. Austin State University. He earned his Ph.D. from the University of Idaho, his M.S. from Northern Arizona University, and his B.S. from Michigan State University. His research interests are broad, from fire ecology and management to silviculture, range management and community ecology.

David F. Polster, R.P. Bio. #148 is a plant ecologist with almost 40 years of experience in vegetation studies, reclamation and invasive species management. He graduated from the University of Victoria with an Honours Bachelor of Science degree in 1975 and a Master of Science degree in 1977. He has developed a wide variety of reclamation techniques for mines, industrial developments and steep/unstable slopes as well as techniques for the re-establishment of riparian and aquatic habitats. He is the past-president (third term) of the Canadian Land Reclamation Association. He is the treasurer for the Western Canada Chapter of the Society for Ecological Restoration and is the NW Regional Representative on the board of the international Society for Ecological Restoration (SER). He was recently awarded the prestigious John Rieger Award from SER. He served as the alternate mining representative on the board of the Invasive Species Council of B.C. for 9 years, ending last year.

Dave Polster has provided on-site design and direction in the development of reclamation and bioengineering systems for restoration of severely damaged ecosystems. He served as the environmental supervisor for CP Rail's massive Roger's Pass Project. He was responsible for developing the bioengineering systems that have successfully revegetated a portion of the Point Grey cliffs at UBC. Dave has prepared reclamation plans for numerous mines, quarries and gravel pits in Canada. He pioneered the concept of successional reclamation where the aim of the reclamation program is the re-integration of the disturbed site into the natural processes of vegetation succession. He has applied his knowledge in ecology to solving problems of unwanted and invasive vegetation. He has authored numerous papers and teaches graduate level courses on these topics.

Dr. Jamie Schuler is Assistant Professor of Silviculture at West Virginia University. He received his B.S. in Forestry and Forest Biology and M.S. in Forest Management both from SUNY ESF and his Ph.D. in Silviculture from North Carolina State University. His research interests include forest regeneration, forest restoration, plantation establishment, and stand dynamics.

Dr. Jeff Skousen is a Professor of Soil Science and the Reclamation Specialist, Division of Plant and Soil Sciences in the Davis College, Division of Agriculture and Natural Resources Extension Service, West Virginia University. He received his Ph.D. from Texas A&M University, and M.S. and B.S. degrees from Brigham Young University.

Jeff has more than 35 years of experience in coal mining and reclamation. He teaches courses in soil science, environmental science, and reclamation of disturbed soils.

Dr. Skousen's primary research topics are reclamation of disturbed lands and improvement of water quality. His work includes acid mine drainage control and treatment, overburden and soil analyses, oil and gas site reclamation, revegetation of disturbed lands, reforestation, native plant restoration, biomass for bioenergy, and post-mining land use development.

He has published over 275 articles in journals, proceedings, books, and extension publications. He works with other faculty, directs graduate student research, publishes results in journals and proceedings, and presents findings at professional meetings. He also directs the annual Acid Mine Drainage Task Force Symposium, conducts seminars and workshops on mined land reclamation, and consults with state and federal agency personnel, landowners, coal operators, and consultants. He travels overseas to work on land reclamation issues in Asia and Europe.

Dr. Hans M. Williams is Interim Dean of the Arthur Temple College of Forestry and Agriculture at Stephen F. Austin State University and Kenneth Nelson Distinguished Professor of Forestry. He earned his Ph. D. from Auburn University, M.S. from Clemson University and the B. S. F. from Purdue University. He is a SAF Certified Forester. His research and outreach interests include tree physiology, arboriculture, forest tree seedling quality, and forested wetlands restoration and functional assessment.