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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 is welcomed. These papers emphasize changing approaches to the science and technology of landscape revitalization.

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

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or use https://www.soils.org/files/publications/style/chapter-01.pdf

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ABSTRACTS OF PAPERS
RESEARCH PAPERS

BIRD SPECIES' REPONSES TO POST MINE RECLAMATION IN ALABAMA – A PRELIMINARY ANALYSIS[1]

Richard R. Borthwick[2] and Yong Wang

Abstract. Surface mining transforms landscapes and ecosystem functions through the removal of vegetation and soil. Losses of vegetation correlate with declines, displacement, and transformations of songbird communities. Mine reclamation is a legislative requirement that can influence wildlife communities. The purpose of this study was to examine the avian community responses to mine reclamation practices and, as a proxy, assess the potential benefits and limitations of current reclamation approaches. Avian point counts were carried out at 202 plots on mined and surrounding non-mined areas throughout the Shale Hills Region of Alabama. These mines were reclaimed across a 26 year time-frame and using a variety of reclamation techniques. Six of the thirty-six bird species observed in high enough densities for detailed analysis showed differences of interest between reclaimed and random non-mined sites. Two species showed negative density responses: Carolina Chickadees (*Poecile carolinensis*), Hooded Warblers (*Setophaga citrina*). Conversely, densities of Field Sparrows (*Spizella pusilla*), Gray Catbirds (*Dumetella carolinensis*), Pine Warblers (*Setophaga pinus)*, and Prairie Warblers (*Setophaga discolor*) responded positively to mine reclamation. We found that most mine reclamation in the Shale Hills Region of Alabama tended to shift habitat towards open canopy, edge, and grassland habitats. Though our study area tended to have fairly open forest structures (average basal areas around 13 m^2/ha and average canopy closures around 50%), species that responded negatively were often associated with older sites with more closed canopies. Reclamation techniques should incorporate diverse canopy vegetation and thick mid-story cover to promote more complex vertical forest structure.

Additional Key Words: reclamation, diversity, abundance, habitat, succession.

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[1] Paper Presented at the 2015 National Meeting of the American Society of Mining and Reclamation, Lexington, KY ***Reclamation Opportunities for a Sustainable Future*** June 7-12, 2015.

[2] Richard R. Borthwick is a Research Associate at the Department of Biological and Environmental Sciences, Alabama A&M University, Normal, AL 35762; Yong Wang is a Professor of Biostatistics and Wildlife Biology in the Department of Biological and Environmental Sciences, Alabama A&M University, Normal, AL

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HEIGHT OF THREE HARDWOOD SPECIES GROWING ON MINE SITES RECLAIMED USING THE FORESTRY RECLAMATION APPROACH COMPARED TO NATURAL CONDITIONS[1]

Kara Dallaire, Jeff Skousen, and Jamie Schuler[2]

Abstract: Coal is an important source of energy for electricity and is used in making steel and various other products. West Virginia is the largest coal producing state within the Appalachian region. Surface mining of coal drastically disturbs ecologically diverse forests and the reforestation of these areas after mining is an important first step to helping restore their ecosystem functions. After mining, operators are often left with brown and gray sandstone to use as topsoil substitutes. Brown sandstone has been more weathered and has physical and chemical properties that are better for tree growth (lower pH, higher percent fines, and higher available nutrients) than gray sandstone. Two study sites were established on former mine sites in West Virginia to assess the effects of brown and gray sandstone, with and without mulch treatments, on tree establishment. Tree growth data for tulip poplar (*Liriodendron tulipifera* L.), white oak (*Quercus alba* L.) and northern red oak (*Q. rubra* L.), and for soil samples (analyzed for pH, EC, percent fines, and extractable nutrients) have been collected annually for the last 10 years. The pH of brown sandstone was 5.2 to 5.4, gray sandstone was 6.5 to 6.8, and mulch treatments were 7.0. Percent fines ranged from 42 to 60% on all treatments. The mulch treatment had high levels of Ca (197 $cmol_c/kg$). The height growth of each tree species on both mine sites was compared to the growth of trees growing on clear-cut areas at the Fernow Forest, WV. In addition, an estimated site index prior to disturbance was calculated and used to predict tree growth rates based on NRCS soil survey data. Tree heights (25 to 175 cm) on gray sandstone were significantly lower than height on brown sandstone (197 to 544 cm) for all three species. Trees on mulched plots were up to 229 cm taller than trees on un-mulched plots. Tulip poplar height on the brown treatment (544 cm) was greater than on a clear-cut area with a site index 62 at 10 years (503 cm). Tree heights on average were 50% lower on mined sites compared to heights calculated from pre-mining site indices.

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[1] Paper presented at the 2015 National Meeting of the American Society of Mining and Reclamation, Lexington, KY ***Reclamation Opportunities for a Sustainable Future*** June 6 - 11, 2015. R.I. Barnhisel (Ed.). Published by ASMR; 1305 Weathervane Dr., Champaign, IL 61821.

[2] Kara Dallaire (Graduate Student) and Jeff Skousen (Professor), Division of Plant and Soil Science; and Jamie Schuler (Professor), Division of Forestry and Natural Resources, West Virginia University, Morgantown, WV, 26505

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USE OF REFERENCE SITES IN THE EVALUATION OF SOME REHABILTATED NATIVE FORESTS ON SURFACE MINES IN AUSTRALIA[1]

R.N.Humphries[2]

Abstract: The rehabilitation of forest and other woody vegetation ecosystems on mineral extraction sites is common place and a major post-mining land use throughout Australia. Owing to the need for government certification (under Australian and State legislation specified completion criteria which are indicative of rehabilitation goals are or have been achieved) there is often referral to and comparison with reference native vegetation sites.

Examples of the ways in which reference sites have been selected and their limitations are considered in relation to some published examples for the rehabilitation of mineral sand, coal and bauxite surface mines in Queensland and Western Australia. Reference sites have been used for mainly setting mine closure land uses and vegetation types and the evaluation of the success of schemes.

The identification and selection of reference sites requires rigour and justification according to the purpose and context of the comparisons being made. Importantly, the selection and sampling protocols need to be clearly set out and justified rather than, for example, simply stating number and sizes of plots used. This is particularly importance with respect to the bias introduced as the methodology used determines both the outcome and interpretation of the comparison being made. Greater consideration of the above might result in reference sites being more 'fit for purpose' than apparently might be the case.

Another issue relating to the identification and selection of reference sites and their attributes as metrics for evaluation purposes is the matter of their state and condition. The use of mature reference stands rather than similar states to the immature rehabilitated stands needs to be factored in when selecting sites and interpreting the outcomes. In this context the recently suggested CARGIE model might be applied and developed further.

Additional Key words: completion criteria, mineral sands, coal, bauxite

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[1] Oral paper presented at the 2015 National Meeting of the American Society of Mining and Reclamation, Lexington, KY ***Reclamation Opportunities for a Sustainable Future*** June 6-11, 2015. R.I. Barnhisel (Ed.) Published by ASMR, 1305 Weathervane Dr, Champaign, IL 61821.

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http://www.asmr.us/Publications/Journal/Vol 4 Issue 2/Humphries-UK.pdf**QUARRY**

RECLAMATION IN ENGLAND: A REVIEW OF TECHNIQUES[1]

Israel A. Legwaila[2], Eckart Lange, and John Cripps

Abstract. This article reviews different techniques for reclaiming quarries in England. They can be used to reclaim abandoned quarries as well as those that are still operating. A number of reclamation techniques have been developed to revert land that has been quarried for minerals to some productive state. The techniques discussed in this paper include rollover slopes, backfilling, bench-planting, and restoration blasting. These techniques are mainly used to prepare quarry landform to support vegetation, ensure safety at site, as well as accommodate different after-uses. A less conventional method of natural recovery or spontaneous succession is also discussed. Whether applied solely or in combination, the use of these techniques has a potential to enhance the environmental qualities of land degraded by quarrying.

Additional Keywords: daleside; limestone; rollover; after-use; post-mine land-use; environmental design.

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[1] Oral paper presented at the 2015 National Meeting of the American Society of Mining and Reclamation, Lexington, KY ***Reclamation Opportunities for a Sustainable Future*** June 6-11, 2015. R.I. Barnhisel (Ed.) Published by ASMR, 1305 Weathervane Dr, Champaign, IL 61821.

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SWITCHGRASS AND MISCANTHUS YIELDS ON RECLAIMED SURFACE MINES FOR BIOENERGY PRODUCTION[1]

Steffany Scagline[2], Jeff Skousen, and Thomas Griggs

Abstract. Legislation passed by the U.S. Congress in 2007 mandates that 25% of transportation fuels must be made from renewable sources by 2022. Two bioenergy crops that have the potential to meet this mandate are switchgrass (*Panicum virgatum*) and Miscanthus (*Miscanthus x giganteus*). Both species are warm-season perennial grasses and have high biomass production potential under low soil fertility requirements. Biofeedstocks for transportation fuels should be grown on marginal lands rather than prime agricultural land best suited for growing food crops. West Virginia provides an abundance of reclaimed surface mine lands that could be used to produce bioenergy crops. In 2010, two varieties each of switchgrass and Miscanthus were planted in 0.4-ha plots with five replications. This study determined dry matter yields of switchgrass varieties Kanlow and BoMaster and Public and Private varieties of Miscanthus after five growing seasons. All species and varieties were established at Alton, a reclaimed surface mine in central West Virginia. This site was reclaimed in 1985 with 15 cm of soil being placed over mixed overburden. Grass and legume species were planted and soils were initially fertilized and limed according to recommendations. Miscanthus yields after the 5th year averaged 13.7 Mg ha^{-1} for Private and 14.4 Mg ha^{-1} for Public. Switchgrass yields after five years averaged 7.9 Mg ha^{-1} for Kanlow and 7.3 Mg ha^{-1} for BoMaster, which is approaching the yields of switchgrass on agricultural soils in the region. With these recorded biomass yields, switchgrass and Miscanthus are able to provide alternative, more sustainable energy sources, whilst providing a more profitable post-mining land opportunity for surface mined land-owners.

Additional Key Words: Biomass, warm-season perennial grass, renewable energy sources, alternative energy.

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[1] Oral paper was presented at the 2015 National Meeting of the American Society of Mining and Reclamation, Lexington, KY, ***Reclamation Opportunities for a Sustainable Future***, June 6-11, 2015. R.I. Barnhisel (Ed.) Published by ASMR, 1305 Weathervane Dr, Champaign, IL 61821.

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OTHER PAPERS

THE APPALACHIAN REGIONAL REFORESTATION INITIATIVE AND GREEN FORESTS WORK: BRINGING BACK THE FOREST ON SURFACE COAL MINES IN APPALACHIA[1]

H.Z. Angel[2], C.D. Barton, M. French, and P.N. Angel

Abstract: Created by the Office of Surface Mining Reclamation and Enforcement and the seven state regulatory authorities in Appalachia, the Appalachian Regional Reforestation Initiative (ARRI) re-establishes healthy, productive forest habitat on active mines, abandoned mine lands, and mines that were previously reclaimed to non-forested post-mining land uses in the eastern coal fields. Green Forests Work (GFW) is a nonprofit organization formed out of ARRI as an economic development plan for Appalachia, styled after the Civilian Conservation Corps of the 1930s to restore forest ecosystem services on mine-scarred lands and to create jobs in the process. From 2009 to 2015, ARRI and GFW have partnered with state and federal agencies, watershed groups, coal operators, conservation groups, environmental organizations, faith-based groups, and numerous universities, colleges, and high schools to coordinate 217 tree planting projects/events on surface mines throughout Appalachia. This work has resulted in the planting of more than 1.59 million trees on 2,602 acres of previously reclaimed mine sites where reforestation was not attempted or where the results were undesirable. ARRI's and GFW's role in these endeavors is to facilitate communication, provide technical assistance, and to match funding sources with suitable mined land and volunteer groups. The volunteer tree planting events facilitated by ARRI and GFW engaged 645 partner organizations and 11,701 volunteers and natural resource professionals, who contributed approximately 80,017 volunteer hours. Among the volunteers, a total of 6,225 were 24 years old or under, supporting the Secretary of the United States Department of Interior's Engaging the Next Generation Youth Initiative and the spirit of volunteerism across the United States.

Additional Key Words: Legacy Mines, Forestry Post Mining Land Use, Forestry Reclamation Approach, Office of Surface Mining Reclamation and Enforcement, Surface Mining Control and Reclamation Act.

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[1] Oral paper presented at the 2015 National Meeting of the American Society of Mining and Reclamation, Lexington, KY ***Reclamation Opportunities for a Sustainable Future*** June 6 - 11, 2015. R.I. Barnhisel (ed.). Published by ASMR; 1305 Weathervane Dr., Champaign, IL 61821.

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REDUCING SULFIDE OXIDATION IN MINING WASTES BY RECOGNIZING THE GEOMIRCOBIAL ROLE OF PHOSPHATE MINING WASTES - A long journey 1991-2014[1]

M. Kalin[2], C. Paulo, M.P. Sudbury and W.N. Wheeler

Abstract: Oxygen has been considered the main driver of the weathering processes in mining wastes, omitting the role of microbes. Among many approaches to control oxygen access to the wastes, *in situ* treatment of the mineral surface has been tried since the late eighties. Various materials including NPR (Natural Phosphate Rock) were added with the expectation of finding an iron-phosphate coating. Irregular and inconsistent results were obtained when the effluents were evaluated according to NPR stoichiometry; however, the lower dosages showed some improvements in the effluents. Since the results did not consistently produce iron phosphate, any positive effects on effluents were considered accidental and the approach abandoned.

We suspected microbes at work based on basic ecological considerations. Hence 1991, we began experimenting on tailings and waste rock with additions of NPR, postulating that if chemo-lithotrophic microbes on the mineral surface accelerate oxidation, then heterotrophic (oxygen-consuming) microbes would reduce oxidation. Samples from tailings plots where NPR was tilled into the surface were tested for pore-water quality after eight years. Effluents from waste rock exposed outdoors in drums were monitored for 2.7 years. Repeatedly, the one-time addition of NPR produced effluents with elevated pH and low metal acidity. Later, microscopic investigations of the rocks found an organic layer on the mineral surfaces. Investigations by scientists in 6 different universities confirmed the presence of a biofilm as the cause of the reduced acid generation. In 2013, heterotrophs were identified and quantified as they covered the surface of German lignite, following a bioleach testing protocol starting at pH around 1. These findings conclusively showed that the development of heterotrophic biofilms and improved effluents from sulfidic mine wastes are a consequence of adding waste NPR.

We conclude that sufficient evidence has been gathered to prove that the geo-microbial control or *in situ* control of sulfide oxidation is a viable concept. It needs to be pursued to control or curtail acid mine drainage now and in the future. In this paper, we document the evolving ecological thought process over 23 years of research, which lead step by step toward understanding of the effects of NPR on the reduction of sulfide oxidation.

Additional Key Words: Microbes, Sulfide Oxidation, Biofilms, Natural Phosphate Rock, Geo-microbiology

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MANAGING AND ESTIMATING CLOSURE AND RECLAMATION LIABILITIES - A PRACTITIONER'S VIEW[1]

Mike Slight[2] and Harley Lacy

Abstract. With the global mining industry's focus on Sustainable Development, there has been a significant emphasis on mine closure and reclamation performance and reporting through the development of the International Council on Mining Metals (ICMM) Sustainable Development Framework and Principles, the Minerals Council of Australia's (MCA) Enduring Value Framework for Sustainable Development, the Global Reporting Initiative (GRI), and the Equator Principles. In addition financial reporting obligations under International Financial Reporting Standards and the Sarbanes-Oxley Act (2002) have also led to better understanding and improvements with industry closure performance, liability management, and reporting, and provide improved guidance on evaluating and measuring liability. Under these sustainable development principles and financial reporting obligations, mining companies are required to self-regulate their compliance to these obligations for mine closure planning and associated cost estimates across all life cycle phases of their mining projects. Internal processes should be developed within mining companies to better understand their closure liabilities and obligations. The likely closure costs and cost estimating processes should be developed for long-term life of mine (asset) planning and budgeting, financial reporting for corporate balance sheet provisioning purposes, and regulator reporting for environmental bonding and financial assurances. Mining companies need to plan for, prepare, and actually "mine for closure" right from the start of a project. This means that their closure and reclamation liabilities throughout each stage of the mine life cycle phases; exploration, during feasibility studies and mine construction, start-up and operations through to the last day of production and beyond, must be understood, planned for, managed, and controlled. This paper will discuss how these closure liabilities are calculated, how they are utilized internally within an organization and what must they deliver in terms of improvement, performance, and reputation. Early recognition of closure and reclamation liabilities promotes improved strategies for operations to plan additional mitigation strategies and anticipate progressive closure and rehabilitation activities. Closure planning creates shareholder value if these long-term liabilities can be reduced or eliminated during operations. A well-established closure planning process combined with a closure and reclamation cost estimating process ensures investment, development, and operating decisions made today are made in full recognition of the potential financial impacts for closure in the future.

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[1] Oral paper presented at the 2015 National Meeting of the American Society of Mining and Reclamation, Lexington, KY ***Reclamation Opportunities for a Sustainable Future*** June 6 - 11, 2015. R.I. Barnhisel (Ed.) Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502.

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ABOUT THE AUTHORS

Ms. Hannah Z. Angel is a graduate student at Stephen F. Austin State University in Texas pursuing a Master of Science degree in Forestry. Hannah is studying the effects of two different reclamation grading techniques on various soil physical and chemical properties, particularly bulk density, at an east Texas lignite surface mine. She also works as a teaching assistant for forest dendrology. In her research, Hannah is interested in contributing to the advancement of the science of surface mine reforestation by applying basic forestry and soil techniques to improve forest growth and productivity. Hannah graduated from the University of Kentucky in 2014 with a Bachelor of Science degree in Forestry. As an undergraduate, she worked on a research project dealing with the survival and growth of advanced backcross American chestnut seedlings planted on post-bond release surface mines in eastern Kentucky. She also has planted trees for the Appalachian Regional Reforestation Initiative and Green Forests Work on unused, post-bond release surface mines throughout Appalachia. Her long-term objective is to work as a professional forester in the field conducting forestry reclamation and other aspects of ecological restoration.

Dr. Patrick N. Angel is a native of eastern Kentucky and has been employed by the Office of Surface Mining Reclamation and Enforcement (OSMRE), United States Department of Interior, in London, Kentucky since the implementation of the Surface Mining Control and Reclamation Act (SMCRA) in 1978. Dr. Angel supervised the inspection and enforcement operations for OSMRE in the coal fields of Kentucky until he was appointed Senior Forester and Soil Scientist for the agency in 2005. He is currently promoting reforestation partnerships on active, abandoned, and legacy surface mines through the Appalachian Regional Reforestation Initiative and Green Forests Work. Dr. Angel is a graduate of Stephen F. Austin State University, Nacogdoches, Texas with a BS and MS in Forestry. He is also a graduate of the University of Kentucky, Lexington, Kentucky with a Ph.D. in Soil Science. The focus of his studies was the reforestation of surface mines.

Dr. Christopher D. Barton is the Director of the University of Kentucky's Appalachian Center and Professor of Forest Hydrology and Watershed Management in the Department of Forestry. As a Research Hydrologist with the USDA Forest Service, Savannah River (1999 – 2003), his work focused on hydro-chemical processes associated with restoration and remediation of disturbed and/or contaminated ecosystems. Dr. Barton is currently working in the areas of ecosystem restoration, reforestation and remediation primarily in stream and wetland habitats and mined lands. In addition, improved methods for preventing water quality degradation from logging and mining activities are currently being examined. Dr. Barton is an Associate Editor for the International Journal of Phytoremediation and the International Journal of Mining, Reclamation and Environment. Dr. Barton is also currently serving as the co-Team Leader of the Appalachian Regional Reforestation Initiative's Science Team and founder of the Green Forests Work program. Dr. Barton was recently honored as the American Society of Mining and Reclamation's 2015 Richard and Lela Barnhisel Researcher of the Year Award.

Dr. Richard Borthwick is a research associate and adjunct professor of Zoology and Biology at the Department of Biological and Environmental Science of Alabama A&M University. He has a Bachelor's degree in natural resource management and wildlife and fisheries from the University of Northern British Columbia, Canada, and a Master's degree in biology – ecology from Alabama A&M University. He has spent ten years as a consulting wildlife biologist and ecologist, and has spent the last three years conducting research on avifauna ecology on reclaimed surface mines. Richard Borthwick is a Registered Professional Biologist with the College of Applied Biology. His current research interests include populations and community ecology, landscape ecology, and the consideration of cumulative and compounding effects of developments and current management practices.

Dr. John Cripps is an Engineering Geologist with research interests in the behavior of rock and soil materials and masses in civil engineering, quarrying and environmental situations, including the reclamation and restoration of quarries. With over 120 publications, he recently retired as a Senior Lecturer in Engineering Geology in the Department of Civil and Structural Engineering at the University of Sheffield.

Ms. Kara Dallaire graduated with a BS degree in Environmental and Conservation Sciences in Land Reclamation from the University of Alberta in 2007. She also attended the Biological Sciences Technology and Environmental Science program at Northern Alberta Institute of Technology and received a diploma in 2004. After graduation in 2007, Kara secured a position with AMEC, a world-wide consulting firm, where she was involved in pre- and post-disturbance assessments for reclamation planning on oil sands developments in northern Alberta. In 2014, she began an MS degree program at West Virginia University where she is evaluating the growth of hardwood trees on surface mines.

Mr. Michael French is a graduate of the University of Kentucky and has more than a decade of experience working the in the field of surface mine reforestation throughout the Appalachian region. Michael currently works for both The American Chestnut Foundation and Green Forests Work and lives in Indiana with his wife and two boys.

Dr. Thomas Griggs is an Associate Professor of Agronomy with emphasis on forage growth and quality. He has worked at West Virginia University for 7 years. His interests include plant-animal interactions in pastures, forage quality evaluation, pasture botanical composition, extended-season grazing to reduce hay-feeding costs, winter and early-season grazing impacts on pasture productivity, root responses to pasture management, bioenergy feedstock production and composition, and the broad range of ecosystem services that grassland agriculture provides.

Dr. R. Neil Humphries is currently the Environmental Co-Coordinator for Celtic Energy's coal mining operations in the UK, whilst still practicing as an independent consultant for other mineral resource companies. He is a chartered biologist and soil scientist who specializes in the reconstruction of ecosystems and the development of reclamation practices, a Fellow of the Institute of Quarrying and holds a Visiting Professorship at Cranfiled University's National Soil Research Institute. His 40 years of practical and research achievements was recently recognized by his receipt of ASMR's William T Plass Award 2013.

Ms. Margarete Kalin is the president and founder of Boojum Research Limited, a small, Toronto-based firm which develops and implements ecologically-based, self-sustaining decommissioning systems for mine waste management areas. She has been an adjunct professor at University of Toronto, Ryerson University, University of Windsor and Queens University. Her publications number more than one hundred including many book chapters, not counting research reports on the fieldwork detailing decommissioning approaches of mine waste management areas utilizing algal and microbial processes within mining wastes and water by controlled application of nutrients, to create reducing conditions within which metals are re-mineralized. he 'swamp doctor' has applied her technology to effluent streams from coal, uranium, base metal and precious metals mines and mine sites in North and South America and Europe. She is the recipient of the Noranda Award for Outstanding Achievement in the Field of Land Reclamation and the Teck-Cominco Environmental Award and, in 2005-06, was a Distinguished Lecturer for the Canadian Institute of Mining. She is a Qualified Environmental Professional with the Institute of Environmental Practice and Senior Ecologist with the American Ecological Society.

Mr. Harley Lacy has had 35 years in the work force undertaking tasks associated with Agriculture, Mining and Environment. Post University he became Environmental Adviser to Dominion Mining Limited's' five mines and Corporate office. Harley founded Outback Ecology in 1990 a consultancy while working on environmental issues in the mining industry. MWH Global acquired that group and the Outback brand in 2013. Today Harley is Lead Mining Consultant Asia Pacific for MWH Global. He co-ordinates projects across the region in mine management consultation, mine closure, tailings research and decommissioning, waste landform design and rehabilitation, diligence audits and rehabilitation techniques and planning. Most recently he was a lead author of the update to the Leading Practice Sustainable Development in Mining for Mine Closure 2015.

Dr. Eckart Lange is Professor at the Department of Landscape at the University of Sheffield. He holds a Dipl.-Ing. in Landscape Planning from the TU Berlin, a Master in Design Studies from Harvard University and a Dr. sc. techn. from ETH Zürich. He is a member of the scientific committee of the European Environment Agency in the area of spatial planning and management of natural resources and the first academic fellow of the Landscape Institute. His research focuses on how landscape and environmental planning can influence anthropogenic landscape change, while developing innovative methodologies of how advanced virtual landscape visualizations and modeling can be used to explore human reaction to these changes.

Dr. Israel Legwaila is a landscape architect with a Master of Landscape Architecture degree from North Carolina State University (USA) and a PhD in Landscape from the University of Sheffield, England. He is a lecturer in landscape planning, design, development and management at the Botswana College of Agriculture (University of Botswana). He has been teaching and doing research at the college since 2001. His research interests are in the use of indigenous plants in landscapes, park planning, design and management and most importantly reclamation of mined sites.

Mr. Jamie Schuler (bio and photo are not available.)

M. Carlos Paulo is currently a Ph.D student at University of Toronto in Geomicrobiology. His interests include the role of microbes in mineral formation in extreme environments; metal adsorption and biologically enhanced Carbon Sequestration and Storage. Before engaging in his PhD, he worked as an environmental consultant from 2003 to 2011. He performed numerous site investigations in mining sites and quarries and help develop strategies for remediation and environmental impact mitigation. He holds a bachelor degree in Geology (University of Coimbra) and a MSc in Geo-resources from the Technical Superior Institute of Lisbon.

Mr. Michael Sudbury is a professional engineer (APEO) who has been associated with the with the mining and mineral processing industry for over sixty years in a wide variety of roles including mineral processing operations; research development and management in the fields of mineral processing; smelting and refining; recycling of metals and minerals and metals; and promotion of environmental improvement, management and control. He is a long term member of a number of technical societies (CIM, AIME-TMS, AWMA-QEP, IOM3) and in nominal retirement has been focusing on both metallurgical history and the promotion of break-through technology in the mining industry with a focus on clean technology, by-product utilization, evaluation of concepts for recovering metals and energy from ultra-deep mineral deposits, and the potential of biological systems for improved control of mining industry effluents and the beneficial sequestering of carbon dioxide.

Ms. Steffany Scagline grew up in Monongahela, Pennsylvania. She graduated with a Bachelor's Degree in Environmental Protection from West Virginia University. Steffany is currently a graduate research assistant in the Division of Plant and Soil Science researching biomass production on reclaimed surface mines for biofuel.

Dr. Jeff Skousen is a Professor of Soil Science and Land Reclamation Specialist. He specializes in acid mine drainage control and treatment, bioenergy crops, and post-mining land use development. He has worked at West Virginia University for 30 years.

Mr. Mike Slight is a senior mining operations executive with over 40 years' experience to General Manager Level in all phases of mining from feasibility, construction and development, production and expansion through to mine closures. Mike provides operational and project management, peer review and environmental and mine closure advice to many mining companies across Australia. He is a member of the University of Queensland's Centre for Mined Land Rehabilitation (CLMR) advisory board and chair of the Mining Rehabilitation Fund Advisory panel of the Department of Minerals and Energy of Western Australia.

Dr. Yong Wang is a Professor of Wildlife Biology and Biometry at the Department of Biological and Environmental Science of the Alabama A&M University. He has a B.S degree in biology from Shanghai Normal University of China and a doctoral degree in biology from University of Southern Mississippi. He worked as a post-doctoral wildlife biologist at Rocky Mountain Research Station of USDA Forest Service. Yong Wang is a fellow of American Ornithologists' Union and a senior certified ecologist of Ecological Society of American. His current research interest areas include the relationships between forest management practices and wildlife communities including birds and herps, stopover ecology of songbird migrants, and modeling spatial and temporal patterns of forest and wildlife community using statistical, geographic information system, and remote sensing technology.

Mr. William Wheeler is a research biologist with Boojum Research. Prior to his tenure with Boojum, he has held research positions at a number of universities and research institutes in Germany, Canada and the USA. He has also held the position of Research Director with Marine Bio-products Intl and Agar Technologies of Canada and Neushul Mariculture Inc. the United States. His fields of interests are plant and algal physiology and biochemistry, with an emphasis on nutritional physiology.