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Spring 2020

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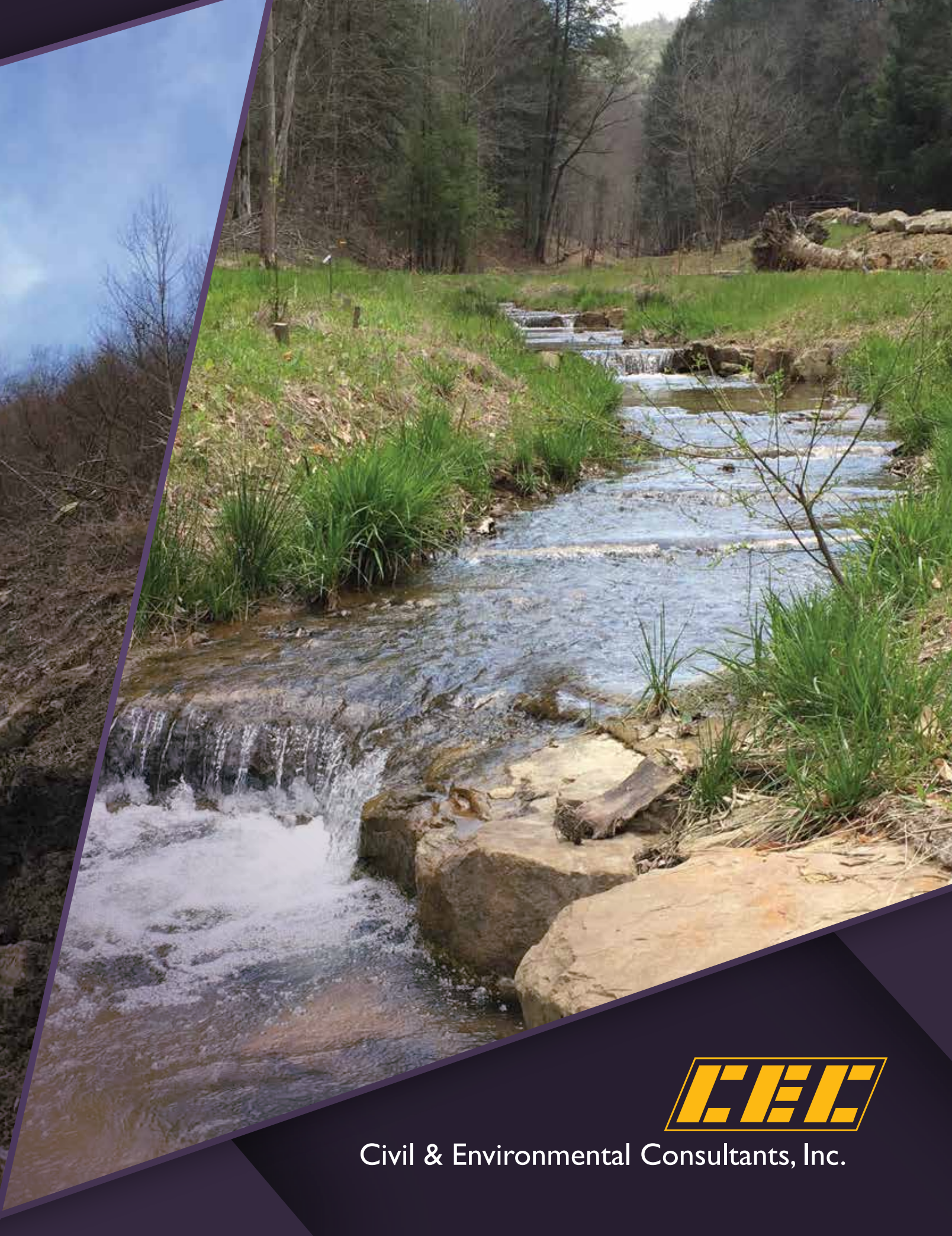


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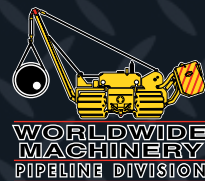
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What's in a Name?

By Kevin Harvey, President of ASMR

As most of you now know, the membership of the American Society of Mining and Reclamation (ASMR) voted this past fall to adjust the name of our society to the American Society of Reclamation Sciences (ASRS). The two voting rounds that completed the name adjustment followed (1) a membership meeting at the annual conference in June 2019 at Big Sky, Montana, which generated valuable input regarding a name change; and (2) several months of analysis by the elected National Executive Committee (NEC) of the ASMR. This process that resulted in the name adjustment was carried out in accordance with the strategic plan for the society that was approved in December 2018.

As background, it is important to note that our society's name and identity have changed throughout the years, and that the society has prospered as a result. The ASMR was originally known

as the Council for Surface Mining and Reclamation in Appalachia, followed in 1978 as the American Council for Reclamation Research and in 1982 as the American Society for Surface Mining and Reclamation, and most recently in 2001 as the American Society of Mining and Reclamation or ASMR. The initial impetus for the society was the need to respond to the extensive impact of current and historic surface mining for coal, and especially to the Surface Mining and Control and Reclamation Act (SMCRA), passed in 1977. Over the years, as the need for reclamation has expanded to other types of mining and industries, the expertise that ASMR members possess, foster, and practice has grown beyond coal mining, and indeed, beyond mining.

The primary purpose of the strategic plan of 2018 was to identify what the society currently represents, and what



we want the society to be going forward. During the strategic planning process, we underscored the fact that applied reclamation science is just as important to numerous other industrial sectors and their disturbances to land and water resources as it is to the mining industry. We also learned that the membership of the society and participation at the annual meetings were on the decline. Armed with these two realizations, it was clear that in order to reverse the drop in membership and annual meeting attendance, all we might have to do is be more inclusive. This is not to say that the society does not already include a wide variety of users, researchers, students, consultants and regulators involved in reclamation beyond mining. What we are saying is, that if this is the case, we should promote the society in a way to broaden its scope and increase membership and attendance at annual meetings. More importantly, and at the same time, we would be increasing our shared knowledge and experience with the application of reclamation science across the world.

Consequently, the NEC and the membership of the society have recognized that the term "mining" in the name might unnecessarily limit the public perception of the expertise and interests of our members and those that depend on our expertise. Our goal moving forward is to attract new members and broaden our expertise and talents into the broad discipline of applied land and water reclamation sciences associated with all types of mining, oil & gas extraction, conventional and alternative energy production, contaminated land remediation, agriculture, road construction, large scale commercial development,

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and other disturbances to land and water resources.

ASMR members attending the 2019 Annual Meeting in Big Sky were briefed on the status of a possible name change and asked to provide input. This input was extremely valuable and led to the short listing of four name adjustment proposals for our society. A few months after the annual meeting in Big Sky, the membership was invited to vote on a name from the four, and this initial vote was followed up by a runoff vote for the two most popular suggestions, resulting in American Society of Reclamation Sciences (ASRS) being selected.

I must admit, for me personally, I was nervous about the elimination of the word "mining" from the name of our society. My education and career began in mining and mine reclamation. My graduate education was paid for by mining. But after nearly 40 years in the natural resource management and reclamation business, I will be completing my career practicing reclamation science across numerous sectors, including mining, oil and gas production, land remediation, and alternative energy generation. I also find comfort in knowing that our organizational cousins across the world also identify themselves by the discipline of reclamation, and not by any single industry association. Examples include: the Canadian Land Reclamation Association, the British Land Reclamation Society, and the International Affiliation of Land Reclamationists. And now there is the American Society of Reclamation Sciences.

Change is not easy, especially in an organization as old as our society, now in its 38th year. This is not the first time the society has adjusted its name. But it does represent a significant first step in the implementation of our strategic plan. I want to thank and congratulate all the members who participated in this process and voted. The membership at the business meeting at Duluth in June 2020 will be appraised of the planned roll out of the name adjustment, as well as the associated rebranding, and efforts to expand the vision and mission of our society. I look forward to seeing you all there! ■

The 80/20 Rule

By Jeff Skousen, West Virginia University

The 80/20 Rule was conceived by economist Vilfredo Pareto. In 1896, he observed that 80 percent of Italy's land was owned by 20 percent of the people. He became obsessed with this ratio, seeing it in almost everything. The Pareto Principle declares that roughly 80 percent of the effects come from 20 percent of the causes. While the ratio might shift slightly one way or another, the 80/20 rule applies to many situations, organizations, activities, and phenomenon. Here are some examples:

- 20 percent of the workers generate 80 percent of the product
- 20 percent of the customers account for 80 percent of the profits
- 20 percent of the volunteers do 80 percent of the work

On social media, it seems that 20 percent of the people on Facebook create 80 percent of the posts!

But it also reflects negative outcomes:

- 20 percent of workers in an organization cause 80 percent of the problems
- 20 percent of the computer bugs cause 80 percent of the computer crashes
- 20 percent of the factories produce 80 percent of the pollution

Does this 80/20 principle apply to you and me? Are we one of the 20 percent of the people in the company that produces quality results, one of the 20 percent that contributes to the overall well-being of an organization, or one of the 20 percent that is always there to complete the task? Or are we one of the 20 percent that shows

little productivity, one of the 20 percent that complains constantly, or one of the 20 percent that never shows up or does the littlest amount of work possible?

While many lessons could be learned from this principle, here are three.

Lesson #1: Focus our efforts on the 20 percent that account for 80 percent of the results.

Focusing on the 20 percent that produce results helps us be more fruitful, effective, and efficient. While we cannot forget the other 80 percent, we could spend less time and effort on those situations or conditions. For example, if 20 percent of the customers produce 80 percent of a company's profits, then the company's sales reps would be wise to direct their best efforts to these 20 percent of customers. And the reverse

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is also apparent; while those other customers cannot be forgotten or ignored, less effort and time could be spent on the 80 percent of customers that contribute little profit. While a few of these 80 percent can be revitalized or energized with some concerted effort, the challenge is to select those with the most potential to be contributors or find new ones.

Lesson #2: Minimize our attention and efforts on the 20 percent that present 80

percent of the problems.

While we all must handle problems and confront difficult circumstances, spending most of our energy on these situations can be debilitating and depressing.

Consider the experience of a piano teacher, who said that 10 of her 50 piano students regularly caused her to consider quitting. While 40 of her students did well and were a delight to teach, the other 10 students wouldn't

practice, they didn't care, and they weren't responsive to her as a teacher. As a result, the teacher spent much of her time worrying how to motivate and coax the poor students to practice and become interested in music. When one of the students finally exploded during a lesson and threw her books across the room, the teacher said to the student's mother that she would no longer be the child's piano teacher. Several hours later she recognized how happy and light-hearted she felt, and she realized it was because she wouldn't be teaching this student again. Within a week, she decided to stop teaching several other problem students and this decision resulted in much greater fulfillment in her piano teaching. Being selective about where and how we spend our time and energy is important to a happy fulfilled life.

Lesson #3: Recognize that we will interact with all types of people.

Most of us cannot be choosy or expect to select only the best opportunities or circumstances. We must spend time and effort on things that often will not result in great outcomes. As we work in unproductive situations or with difficult people, we must do the best we can, have patience, move forward, and not be discouraged.

Applying this principle to our lives will help us be more committed and productive employees and citizens by desiring and working to be in that top 20 percent of industrious people. By prioritizing our time and efforts on that which is most important, we will reduce stress and competing interests. And we can be more careful in selecting those activities and efforts that tend to bring us joy and satisfaction. We should ask, "Are we giving our energy and best efforts to those things and people that matter most?" As we prioritize and focus, I am confident we will increase our efficiency in our labors, appreciate the people with whom we work, and improve our quality of life. ■

**Thanks to Hannah Beckett and James Thompson for helpful comments.*

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Message from Early Career Professionals

By Hannah Angel and Hanna Patton

As I, Hannah Angel, transition out of the Early Career Professional (ECP) representative position in June of this year, I am working with Hannah Patton and Kenton Sena (ECP in Kentucky) to develop effective ways to connect students and ECPs not only with each other but also with mentors both during and between conference meetings. I am excited to see what the future holds for the student/ECP community within our society.

We look forward to seeing you at the meeting in Duluth if you plan to attend! Special events for the student/ECP community include:

Tuesday Morning Student Breakfast

Students at all levels: Join us for breakfast and active round-table discussion on various career paths, including advice from experienced students/professionals.

Wednesday Evening Early Career Professionals Event

Students and ECPs will engage and network with experienced professionals at Hoops Brewing in Canal Park.

To stay connected and updated on events, job postings, meetings, etc. within the student/ECP community, please join our Facebook Group: <https://www.facebook.com/groups/asmr.ecp/>

Feel free to reach out if you have any feedback or questions.

Meet Hannah Patton, the incoming Early Career Professionals (ECP) Representative!

Hannah Patton is a PhD student in the Biological Systems Engineering Department at Virginia Tech in Blacksburg, Virginia. Hannah is an EIT and holds a BS in Environmental Engineering from Saint Francis University and an MS in Biological Systems Engineering from Virginia Tech. Hannah began her research career as an undergraduate at Saint Francis University, where she studied acid mine drainage remediation in Western Pennsylvania and Potosí, Bolivia. As a graduate student, Hannah's research focus shifted from the reclamation of mine-impacted land and water toward the reclamation of mine-impacted communities. Hannah's PhD research is centered on drinking water quality and source selection in the Central Appalachian coalfields. Hannah works with community members in Virginia, West Virginia, and Kentucky to collect and analyze drinking water samples from homes and roadside springs, and to learn more about water infrastructure challenges in the region. Hannah enjoys trail running, hiking, whitewater



Hannah Patton taking a water sample for analysis.

rafting, skiing, climbing, and eating burritos. She is looking forward to serving as the ECP Representative in the coming years and is committed to improving career and academic opportunities for students and young professionals in the society.

Hannah Elisabeth Patton

hpatton@vt.edu

Hannah Zoe Angel

ECP Representative | angelhz@vt.edu ■

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Extra Activities

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Who/What: Anyone attending the conference is welcome and encouraged to meet up for a social pace run or walk to enjoy the sites and scenery Duluth has to offer. The Lakewalk along Canal Park is one of the must see recreation areas in Duluth. A short distance from the Duluth Entertainment Convention Center, the area will be an excellent place to get some exercise prior to conference proceedings each day. Some people stay with the group for part of the run and then branch off to go faster, farther or slow down. Some years we have a running group, a walking group, and a fast-paced training group. These morning activities are a wonderful way to meet new people, catch up with old friends, and get some exercise. Remember to bring your walking or running shoes!

Where/When: Meet at 6:30 a.m. at the Hampton Inn lobby, and then head as a group up to Gichi-Ode' Akiing (Lake Place Park), Monday through Thursday during the conference.

Contact:

Ryan Mahony ryan@biomost.com.



Wild Women of Reclamation

To: All women involved in reclamation – feel free to bring a colleague!

When: 7:00am–8:15am, Monday, June 8th.

Where: Duluth Entertainment Convention Center (French River Room), Duluth, Minnesota

Wild Women of Reclamation (WWR) originated in Laramie in 2013 as an idea of Brenda Schladweiler. WWR became an integral part of the agenda at the 2014 national meeting of the American Society of Mining and Reclamation. Participants meet before the morning talks at a kickoff breakfast early in the conference. Every woman is welcome. We enjoy a few presentations, promote networking, get to meet a lot of new attendees, and catch up with a few friends.

Presentations in the past have dealt with choosing your own path, mentoring, starting your own business, and juggling a research career with family and community obligations. The presentations have had one theme in common: adaptability. Feedback from participants at the breakfast meeting and after indicated that those participants just starting their careers appreciated the honest feedback on “how it used to be” and, in many ways, “how it still is.”

To keep the energy going throughout the year, we divide the group into “more experienced” individuals (i.e., greater than five years in your career) vs. “less experienced” (i.e., less than five years). One person from each group is paired with one from the other group. Those mentors and “mentorees” are then given the assignment to keep in touch with each

other throughout the coming year. This is an easy way to build up contacts, bounce ideas, and to learn about other careers. We have a newsletter that goes out several times a year, or as often as we can get stories. After the first newsletter went out, we had many requests from women not yet members of ASMR requesting to be added to the circulation list. Please keep those stories coming!

This will be the seventh annual WWR meeting at ASMR. We will continue this tradition by meeting Monday morning at 7 a.m., so please join us. We are lining up two inspirational women speakers on the agenda. So far, Dr. Abbey Wick, Assistant Professor, Extension Soil Health Specialist at North Dakota State University, has confirmed her speaking engagement. Abbey has a way of making soil science very interesting – just check out her videos on <https://www.youtube.com/channel/UCco9hmhulafRu1VxAPOrNgA>. We hope to announce the second speaker in the very near future!

There is no membership to Wild Women of Reclamation – just camaraderie and networking! We will have a light breakfast of coffee/ tea/ muffins so just come on over to the Convention Center on Monday, June 8 at 7 a.m. and join us! If you end up arriving late for whatever reason, still come into the room. We will be there until 8:15 a.m. We look forward to seeing as many of you as can make it. Feel free to bring a friend or new colleague. We've included last year's picture of the group in Big Sky. ■

Contacts:

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Cindy Adams: cindy@ecopoint-inc.com
Rachel Hohn: rachelhohn@gmail.com



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The 37th Annual Meeting of the American Society of Mining and Reclamation (ASMR) represents a unique opportunity to focus on the research, technical, and regulatory issues associated with restoring land and water resources following anthropogenic land

disturbances. It will provide a forum for the dissemination of information through presentation of research findings, field tours, and open discussion of public policy relating to the applied science of reclamation, rehabilitation, remediation, and restoration of areas disturbed by mining, oil & gas, conventional and alternative energy production, contaminated sites, agriculture, road construction, large-scale commercial development, and other disturbances to land and water resources.

The conference convenes at the Duluth Entertainment & Convention Center (DECC), conveniently located on the waterfront in Duluth's Canal Park. Pre-conference activities include two field trips on June 7th, highlighting reclamation and recreational re-use of

mined lands, followed by a Welcome Reception at the DECC. The Plenary Session will begin our technical program on Monday, June 8th, followed by the ASMR Awards Luncheon. Monday Evening features the Social Event at the gilded age museum Glensheen Mansion, operated by the University of Minnesota-Duluth. After a day of technical sessions on Tuesday, mingle as at the Poster Session prior to attending ASMR's second annual Reclamation Film Festival. Wednesday afternoon's offerings include two technical workshops, and an opportunity to see reclamation in action at Duluth's area streams. Post-conference events include a tour of peat mine reclamation, or a tour of estuary restoration in the Duluth Harbor.

See you on the shores of Lake Superior!





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FILED TRIP COMMITTEE:

Marsha Patelke	University of MN, Duluth
Paul Eger	Global Minerals Engineering
Paula Giryn Lillesve	Hibbing Taconite Co.
Thomas Lee	Minnesota Department of Natural Resources
Rory Olberhelman	PolyMet Mining

MEETING FINANCIAL SPONSORS/EXHIBITORS

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Early Career Professional Event

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Sunday, June 7, 2020

7:30 a.m. – 5:00 p.m. Professional Field Tour #1. Taconite Mining and Reclamation. For more info, see <https://www.asmr.us/Meetings/2020-Annual-Meeting/Special-Events>

7:30 a.m. – 5:00 p.m. Professional Field Tour #2. PolyMet and Giant's Ridge.

8:30 a.m. – 5:00 p.m. Registration – Registration Lobby

10:00 a.m. – 5:00 p.m. Exhibitor Setup – Edmund Fitzgerald Hall

12:00 a.m. – 5:00 p.m. NEC Lunch/Meeting – Board Room

6:00 p.m. – 8:00 p.m. Welcome Reception – City Side Convention Center Lobby

All day ASMR Office – Split Rock Room

Monday, June 8, 2020

6:30 a.m. – 7:30 a.m. Haulin' ASMR – Meet at Hampton Inn Lobby

The ASMR Running group, meets every morning. From the Hampton Inn run will go up to Gichi-Ode' Akiing (Lake Place Park) and get onto the Lakewalk.

7:00 a.m. – 8:15 a.m. Wild Women of Reclamation – French River Room

Participants meet before the morning talks. Presentations in the past have dealt with choosing your own path, mentoring, starting your own business, and juggling a research career with family and community obligations. Coffee, tea, and pastries will be provided.

7:30 a.m. – 5:00 p.m. Registration – Registration Lobby

9:00 a.m. – 5:00 p.m. Exhibitor Displays – Edmund Fitzgerald Hall

9:00 a.m. – 6:00 p.m.

Silent Auction opens – Split Rock Room

10:00 a.m. - 12:00 p.m.

Cultural Event #1 – Vista Boat Tour (~2 hours)

8:30 a.m. – 9:30 a.m.

Plenary Session – Lake Superior Ballroom

Mehgan Blair – Conference Chair – Welcome

Kevin Harvey – ASMR President – President's Welcome and Keynote Address

Robert Darmody – ASMR Executive Director – Welcome & Announcements

9:30 a.m. – 10:00 a.m.

Keynote Speaker – Mark Phillips, Commissioner

A reclamation update from the Minnesota Iron Range Resources and Rehabilitation (IRRR)

10:00 a.m. - 10:30 a.m.

Break – Edmund Fitzgerald Hall

10:30 a.m. – 12:00 noon

Keynote Speakers

Melissa Sjolund - MN Dep. Nat. Res., St. Louis River Restoration Initiative, will speak on: Remediation, Restoration, and Revitalization in the St. Louis River Area of Concern

Dan Powell - Chief of the Technology Integration and Information Branch, U.S. EPA's Office of Land and Emergency Management will update federal reclamation initiatives.

12:00 noon – 1:45 p.m.

AWARDS LUNCHEON / ASMR BUSINESS MEETING

2:00 – 5:30

Technical sessions - Gooseberry Falls Rooms

6:00. – 9:00

Social Dinner at Glensheen Mansion

MONDAY, JUNE 8, TECHNICAL SESSIONS

	Novel Approaches to Native Vegetation SESSION 1A - Gooseberry Falls Room 1	UAV Monitoring and Modeling SESSION 1B - Gooseberry Falls Room 2	Mine Waste Characterization and Remediation SESSION 1C - Gooseberry Falls Room 3
2:00 p.m. – 2:30 p.m.	Texas Native Seeds: a regionally based seed development program to enable state level grassland restoration. By A.D. Falk, F.S. Smith, and K.A. Pawelek	Using Unmanned Aerial Vehicles to Monitor Erosion Control Measures on a Reclaimed Central Utah Coal Mine. By Christopher Brown*, R. Douglas Ramsey, Thomas Thompson	Superfund Remediation at Tar Creek. By Tim Kent and Summer King
2:30 p.m. - 3:00 p.m.	Weeds on oil sands mine reclamation sites in northern Alberta: Are they an issue? By Brad Pinno	Utilizing sUAS-Derived Multispectral Imagery and Spectroradiometer-Derived Hyperspectral Data to Describe Optical Depth and Estimate Trace Metal Concentrations in a Passive Treatment Oxidation Pond. By Brandon Holzbauer-Schweitzer*	Remediation of the Abandoned Hillside Mine in Rural Arizona: A Phased Approach. By L. Steele, D. Longwell, J. Nuttall, J. Sutter, and J. Patricki

3:00 p.m. - 3:30 p.m.	Discovery of Australian native hyperaccumulator plants for developing phytoremediation applications. By Farida Abubakari*, Peter D. Erskine, Guillaume Echevarria, and Antony van der Ent	Linear Regression and Spectral Band Transformations Coupled with sUAS-Derived Multispectral Imagery Fails to Estimate Traditional Water Quality Parameters in Optically Shallow Surface Waters. By Brandon Holzbauer-Schweitzer*	Mercury Contamination from Historic Mining in New Idria, California. By Rachel Hohn*
3:30 P.M. - 4:00 P.M. - BREAK – Edmund Fitzgerald Hall			
	Optimizing Establishment of Vegetation SESSION 2A - Gooseberry Falls Room 1	UAV Monitoring and Modeling (cont'd) SESSION 2B - Gooseberry Falls Room 2	Mine Waste Characterization and Remediation SESSION 2C - Gooseberry Falls Room 3
4:00 p.m. - 4:30 p.m.	Effects of Ripping and Tillage on Upland Pasture Establishment on a Reclaimed Mineral Sands Mine in Southeastern Virginia. By Sara K. Klopff, W.L. Daniels, H. Angel, Z. Orndorff, and R. Daniel	Innovative Technologies to Improve Reclamation Monitoring. By C. Bowles, M. Rawitch, and D. Mumm	Screening native/indigenous species for tolerance to Pb/Zn/Cu tailings and using image-based analysis as a new assessment approach. By M. K. Al-Lami*, D. Nguyen, G. Sutton, C. Neaville, and J. G. Burken
4:30 p.m. - 5:00 p.m.	Ecological Recovery of Templeton Fork Watershed Following Large-Scale Stream and Wetland Mitigation. By M.L. Shema, M.R. Haibach, and M.A. Takacs	Implementing thermal imaging devices equipped to unmanned aerial vehicles to identify grassland bird nests in reclaimed native grasslands. By L.M. Hearon*, J.I. Morrison, and B.S. Baldwin	Applied Research: Biogeochemical Response of PAG Mine Waste to Bactericides and Vegetation. James Gusek and Thomas Clark
5:00 p.m. - 5:30 p.m.	Vegetation Community Dynamics on Soil Islands in Oil Sands Reclamation. By K.E. Trepanier* and B.D. Pinno	Servicing the Countries Mine Map Needs. By Sean J. Chisholm	Co-treatment of circumneutral mine drainage with secondary municipal wastewater for improved water quality. By Charles Spellman*, et al.
			Tailings plus Geotechnical Engineering TD Meetings
6:00 - 9:00 P.M. SOCIAL EVENT: Glensheen Mansion			

Professional Tours 1 & 2 - Sunday, June 7 – 7:30 a.m. – 5:00 p.m.

Professional Tour 1. Taconite



Take in Minnesota's Iron Range mining district at the newly renovated Hibbing Mine View overlooking the Hull Rust Mahoning Mine complex, the "Grand Canyon of the North." From the unique 360° vantage point, one can see the evolution of reclamation on the Iron Range. One of these sites is United Taconite's tailings basin, which has been reclaimed to productive use as farmland, wetland, and a hybrid poplar stand. Another is Hibbing Taconite's 5036 stockpile, an innovative, proactive

reclamation site that will become the future pit lake's littoral zone. In Hibbing, we'll also stop at the Minnesota Department of Natural Resources mine reclamation research facility, home to field- and pilot-scale reclamation demonstration projects and Minnesota's exploration drillcore library. We will visit the Redhead Mountain Bike project to view the development of off-road trails on mined land and the Minnesota Museum of Mining.

Professional Tour 2. PolyMet and Giant's Ridge



The former LTV Steel Mining Company site is home to Minnesota's first permitted Cu/Ni +/- PGE project. PolyMet's Northmet deposit is situated adjacent to the Iron Formation, and

features of the site include the partially reclaimed tailings basin. This area has since become a habitat for birds, and work to study those bird populations is ongoing. The tour will also cover the future Cu/Ni project plans, including planned operational and reclamation activities. We will also make stops near Giant's Ridge, a year-round ski and gold recreational destination in Northern Minnesota, which includes the Quarry, a golf course built on a former iron mining property. We'll visit the restored creek area near the facility, which was scoured after the Hector mine pit lake overtopped its spillway in 2017.



Social Event and Dinner - Monday, June 8 – 6-9 p.m.

Join us for a catered dinner and drinks on the lakefront grounds

of the historic Congdon Estate, Glensheen. The home of Henry Oliver's personal attorney, Chester Congdon, this Gilded Age estate is now a museum run by the University of Minnesota–Duluth. The fortunes created by Northern Minnesota iron ore production and eastern steel making are on display, and we'll enjoy self-guided tours of the mansion, the balconies and greenhouse, and the shoreline beaches and gardens. Bus transportation to the mansion included.

Cultural Event #1 – Monday June 8, 10 – Noon - Vista Boat Tour



Enjoy Duluth's lakefront by boat by hopping on the Vista!

TUESDAY, JUNE 9, 2020

6:30 a.m. – 7:30 a.m.	Haulin' ASMR - meet in Hampton Inn Lobby	8:00 a.m. - 5:00 p.m.	Exhibitors – Edmund Fitzgerald Hall
7:00 a.m. – 8:00 a.m.	Student Breakfast –French River Room	8:00 a.m. – 6:00 p.m.	Silent Auction –Split Rock Room
7:45 a.m. - 8:30 a.m.	JASMR Editorial Meeting TBA	7:30 a.m. – 5:00 p.m.	Registration – Registration Lobby
		9:00 a.m. - 12:00 p.m.	Cultural Event #2 Glensheen Mansion Nooks and Crannies Tour

TUESDAY, JUNE 9, TECHNICAL SESSIONS

	Soil Reclamation SESSION 3A - Gooseberry Falls Room 1	Teaching Reclamation SESSION 3B - Gooseberry Falls Room 2 Moderator - Brad Pinno	Passive Treatment of Mine Drainage SESSION 3C - Gooseberry Falls Room 3
8:30 a.m. - 9:00 a.m.	Vegetation Response to Surface Soil Undulation Height. By Gwendelyn Geidel	Introductory field schools at the University of Alberta. By Brad Pinno and Alex Drummond	Meeting the Challenge of Integrating Habitat and Aesthetics into Functioning Treatment Wetlands for Zinc and Manganese . By R.C. Thomas, J.S. Bays, R. Bitely, A. Lewis, J.H. Pries, A.C. Pia, J.L. Meyer, and J.P. Strunk, Jr.
9:00 a.m. - 9:30 a.m.	Effect of Forestry Reclamation Approach Practices on Soil Water Chemistry. By A. Hass, J.G. Skousen, and R. Cantrell	Perspective of a Private Employer – Consultant. By Brenda K. Schladweiler	Solar-Powered Float-Mix Aerators Increase Iron Retention, pH and Dissolved Oxygen and Decrease CO2 in Passive Treatment Oxidation Ponds. By D.M. Dorman* and R.W. Nairn

9:30 a.m. - 10:00 a.m.	Pedogenesis in Appalachian Coal Mine Soils in Southwestern Virginia. By H.Z. Angel*, W.L. Daniels, K.C. Haering, and D.K. Johnson	Restoration Ecology as a First-Year Honors Course: Lessons Learned and Changes Made. By K. L. Sena	Recovered Mine Drainage Passive Treatment Residuals Address Reservoir Sediment Nutrient and Trace Metal Pollution: A Field Mesocosm Study at Grand Lake o' the Cherokees, Oklahoma. By Zepei Tang* and Robert W. Nairn
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10:00 a.m. - 10:30 a.m. BREAK - Edmund Fitzgerald Hall

	Soil Morphology and Chemistry SESSION 4A - Gooseberry Falls Room 1	Teaching Reclamation (cont'd) SESSION 4B - Gooseberry Falls Room 2 Moderator - Brad Pinno	Passive Treatment of Mine Drainage (cont'd) SESSION 4C - Gooseberry Falls Room 3
10:30 a.m. - 11:00 a.m.	Understanding Backfill Methods and Ground Condition Variabilities in Abandoned Mine Mitigation . By Mohamed Gamal, Dave Hibbard, Joel James, and Lindsey French	Teaching Reclamation Techniques to Natural Resources Senior Undergraduate Students. By Jennifer Franklin	The XAS - Using "Big Science" to evaluate metal removal. By Brandy Stewart, Paul Eger, Brandy Toner, and Cody Shiekl
11:00 a.m. - 11:30 a.m.	Scram Tailings Mineland Reclamation 3-year Case Study and Recommendations. By A. Kramer, J. Asp, and N. White	Teaching Reclamation through Applied Curricular and Co-Curricular Experiences. By N.A. Kruse Daniels	New Reagent Medium for Passive AMD Treatment. By M.J. McCluskey
11:30 a.m. - 12:00 p.m.	Beneficial Use of Dredge Sediment for Mine Land Reclamation. By M. M. Patelke, S. Post, and L. M. Zanko	Navigating Graduate School. By K.E. Trepanier*, L.J. Newstead*, L.A. Manchola Rojas*, and K.M.E. Trudel	Preliminary Examination of Possible Fate of Atmospherically Deposited Mercury in Passive Treatment Systems. By J.D. Ingendorf* and Robert W. Nairn

12:00 P.M. - 1:15 P.M. Lake Superior Ballroom

Lunch Speaker: Ryan Edward Peterson

Enterprise and Perseverance: Prehistoric Copper Mining on Isle Royale National Park

Native Peoples have been mining copper on Isle Royale National Park for thousands of years. There at least 15 known prehistoric copper mines on the island, each having multiple pits associated with it. The people would mine the copper and then transform it into tools and trade items. Stroh Messerole will detail the archaeological research of these copper mines on the island and discuss the importance of copper in the lives of prehistoric peoples.

Ryan Edward Peterson, Department of Anthropology, Indiana University. Ryan is a Ph. D. candidate whose work focuses on native copper procurement, production, and exchange in the Lake Superior Basin during the Archaic time period.

Cultural Event #2: – Glensheen Mansion Nooks and Crannies Tour Tuesday June 9, 9- noon.

See the historic Congdon estate in detail! Chartered transportation to Glensheen is included.



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TUESDAY, JUNE 9, TECHNICAL SESSIONS			
	Soil Characterization for Reclamation SESSION 5A - Gooseberry Falls Room 1	Advances in Monitoring, Design, and Closure SESSION 5B - Gooseberry Falls Room 2	Mine Drainage and Watershed Characterization for Reclamation SESSION 5C - Gooseberry Falls Room 3
1:30 p.m. - 2:00 p.m.	Butte Montana West Side Soils Operable Unit Remedial Investigation Sampling using Electronic Field Tool. By N.R. Anton, C. Love, C. Kelley, M. Goldberg, Z. Adams, and N. Greene	Treatment-as-a-Service (TaaS) – Fixing the Cost of AMD Treatment. By M.J. McCluskey	Evaluating Sources, Mass Loadings and Fate of Total and Dissolved Metals to Prioritize Restoration in a Mining-Impacted Watershed. By Robert W. Nairn, Nicholas L. Shepherd, and Julie A. LaBar
2:00 p.m. - 2:30 p.m.	Potentially Acid-Generating Materials in Transportation Corridors: The Role of Regional Geology in Assessment. By D.M. Levitan, W.L. Daniels, and M.M. Blair	Peat Mine Restoration, New Monitoring Technologies, and 5 Years of Progress at the Superior Wetland Bank. By N. A. White, D. Deuschle	Water Quality and Quantity Analysis to Evaluate Passive Treatment Feasibility for Select Mine Drainage Discharges within the Tar Creek Superfund Site. By N.L. Shepherd*, and R.W. Nairn
2:30 p.m. - 3:00 p.m.	Towards understanding the microbial mechanisms underlying the success of <i>Miscanthus × giganteus</i> on Appalachian marginal lands. By J. Kane*, L. McDonald, J. Skousen, E. Morrissey, and Z. Freedman	Cost Saving Closure of Fly Ash Impoundments. By Al Briggs, Ron Froh, and Jay Clayton	Nitrate-dependent iron oxidation driven by bacterial symbionts found in acid mine drainage. By Michelle M. Valkanas*, Taylor Rosso, and Nancy J. Trun
3:00 p.m. - 3:30 p.m. BREAK - Edmund Fitzgerald Hall			
	Regulations and Standards of Reclamation SESSION 6A - Gooseberry Falls Room 1	Reforestation SESSION 6B - Gooseberry Falls Room 2	Watershed Restoration SESSION 6C - Gooseberry Falls Room 3
3:30 p.m. - 4:00 p.m.	Pennsylvania's Abandoned Mine Land (AML) Emergency Program. By Eric E. Cavazza and John J. Stefanko	Evaluating the Influence of the Forestry Reclamation Approach on Hydrology on Appalachian Coal Mines. By C.D. Barton, T.N. Williamson, C.T. Agouridis, K.M. Yeager, W.E. Bond, and M. Gerlitz	Hydraulic design for long-lasting stream and floodplain restoration. By N.A. Kruse Daniels, A. Gurrola, J. South, N. Sullivan, J. Bowman, and N. Kirchner
4:00 p.m. - 4:30 p.m.	Development of International (ISO) Standards for Mine Reclamation. By W. Lee Daniels and Steven Carpenter	Creative solutions to complex ecological challenges: Lessons from an experimental loblolly pine plantation in Kentucky. By K. Sena, J. Metzmeier, B. Smith, E. Hansen, and C. Barton	Fifteen Years of Reclamation Research Partnerships through the Center for Restoration of Ecosystems and Watersheds at the University of Oklahoma. By Robert W. Nairn, Robert C. Knox, Zepei Tang, M'Kenzie Dorman, Juan Arango, Brandon Holzbauer-Schweitzer, and Nicholas Shepherd. (you could add an "et al." after Bob's name to save space)
4:30 p.m. - 5:00 p.m.	Reclamation Vs. Restoration: Are We Really That Far Apart? By Brenda K. Schladweiler and Peter D. Stahl	First-Year Results of Helicopter Liming of Soils in the Monongahela National Forest. By J. Fowler*, J. Skousen, S. Connolly, S. Mellor, A. Nottingham	5036 Innovative Shoreline Planning on the Mesabi Iron Range in Hibbing, Minnesota. By Paula Lillesve

5:00 p.m. - 5:30 p.m.	Pennsylvania's Environmental Good Samaritan Program. By John J. Stefanko and Eric E. Cavazza	Ecology plus Forestry and Wildlife TD Meetings	Sulfate-Reducing Bioreactors for Treatment of High-Acidity AMD: Update of the Performance of the Tab-Simco Passive Treatment System. By Paul T. Behum, Liliana Leticariu, and Krystal Pankey
			Water Management TD Meeting to follow

5:30 P.M. - 7:30 P.M. POSTER SESSION AND NETWORKING EVENT: Edmund Fitzgerald Hall

Poster presentations will be on display, with authors present after the technical sessions finish.

7:30 P.M. - 9:30 P.M. Film Festival – French River Room

Join us for the Second Annual ASMR Film Festival. We will bring reclamation-related topics to you via short (~5-15 minute) films highlighting exciting and intriguing reclamation projects. Awards will be presented to the best in show in Pro and Non-Pro Categories, classic movie theater snacks will be provided.

POSTER SESSION - TUESDAY, JUNE 9 - 5:30 - 7:30 PM Edmund Fitzgerald Hall	
1	Evaluating Technologies for Hardrock Mining Remediation: Information and Data Needs. By: Barbara A. Butler and Michele K. Mahoney
2	Reclamation Soil Placement: Physical and biological effects of topsoil stockpiles vs. direct placement. By: Keana Trudel* and Brad Pinno
3	Buried wood effects on nutrients and microbial communities in different reclamation soils in Western Canada oil sands. By Laura Alejandra Manchola Rojas*, and Bradley Pinno
4	Microbial Recovery in Soils Treated by Ex-Situ Thermal Desorption and Mixing after Crude Oil Spill in Western North Dakota. By: Zachary Bartsch*, Thomas M. DeSutter, and Caley K. Gasch
5	First-Year Survival of Native Wetland Plants in Created Vernal Pools on an Appalachian Surface Mine. By: Anna M. Branduzzi*, Chris D. Barton, and Amy Lovell
6	Alleviating Soil Compaction and Improving Reclaimed Grasslands. By: Maureen A. Puffer* and Ryan F. Limb
7	A timeline of coal mining legislation and regulation in Central Appalachia. By: Nora Sullivan and Natalie Kruse Daniels
8	Assessing the Potential for Beneficial Reuse of Passively Treated Mine Waters for Crop Irrigation. By: Harper Stanfield* and Robert W. Nairn
9	Effects of cropping sequences, tillage, and manure application on crop yields in a pipeline reclamation setting in western North Dakota, By: Nicholas Birkhimer*, Thomas DeSutter, Jery Bergman, Kevin Horsager, Kyle Dragseth, Meridith Ramsey, and Cameron Wahlstrom
10	Effect of Bacteria Encapsulated in Agar Beads on Sulfate Reduction in AMD. By: Taylor Rosso*, Michelle M. Valkanas, Nancy J. Trun
11	Determining the Effect of Mine Drainage Residuals on Phosphorus Sequestration and Rye Grass Yield. By: Matthew Berzonsky*, Benjamin Dumm, Travis Tasker, William Strosnider James Eckenrode, Sarah White, and Robert Hedin
12	Evaluation of Peat Sorption Media for Metal Removal from Stormwater from a Mineral Processing Facility. By: A.D. Vaslow*, C.L. Kairies-Beatty, P. Eger, P. Jones, and D. Green
13	Determining Factors Affecting Peat Reclamation in Mined Peatland Areas. By: L.J. Swenson*, C.L. Kairies-Beatty, P. Eger, and P. Jones
14	The Current Situation and Reclamation Planning of Coal Mining Subsidence Land in Shandong, China By: Dongzhu Yuan* and Zhenqi Hu
	* Denotes Student

FILM FESTIVAL – TUESDAY, JUNE 9 - 7:30 - 9:30 PM French River Room

Join us for the Second Annual ASMR Film Festival. We will bring reclamation-related topics to you via short films highlighting exciting and intriguing reclamation projects. Awards will be presented to the best in show, and classic movie theater snacks will be provided.

1	Drones and Pocking in Utah, by Christopher Brown*, Douglas Ramsey, and Thomas Thompson
2	Our Work's Not Done, by Eric Cavazza
3	pH7, by Chad Reich, N.A. Kruse Daniels
4	Responding to Acid Deposition on the Monongahela National Forest by Jarrett D. Fowler
5	Macleod Mine Water Treatment Plant, by Riccardo Schiavone
6	Interstate Island Restoration and Stabilization Set to Rescue Rare Common Tern Population, by Natalie White
7	Miami (Oklahoma) Vice: Addressing Environmental Degradation Through Student-Driven Research, Partnerships, and Natural Infrastructure, by Brandon K. Holzbauer-Schweitzer, etc.
	* Denotes Non- Professional Videographer.



For the most up-to-date conference information, please log on to our app – <https://yapp.us/?>

or

ASMR's website, <https://www.asmr.us/Meetings/2020-Annual-Meeting>.

WEDNESDAY, JUNE 10, 2020

6:30 a.m. – 7:30 a.m.	Haulin' ASMR - Meet in lobby	8:00 a.m. - 11:00 a.m.	Silent Auction – Winners announced at lunch.
7:30 a.m. – 5:00 p.m.	Registration - Registration Lobby		
8:00 a.m. - 5:00 p.m.	Exhibitors – Edmund Fitzgerald Hall	12:00 p.m. - 2:30 p.m.	Cultural Event #3. North Shore Scenic Railroad Train Excursion

WEDNESDAY, JUNE 10, TECHNICAL SESSIONS

	Partnerships in Reclamation SESSION 7A - Gooseberry Falls Room 1 Moderator - Abbey Wick	Reclamation for Community Reuse SESSION 7B - Gooseberry Falls Room 2	Land Reclamation and Preservation SESSION 7C - Gooseberry Falls Room 3
8:30 a.m. - 9:00 a.m.	Teaching Young and Old Pups New Trick. By T.J. Toy, W. Lee Daniels, S. Flath, B. Schladweiler, A.F. Wick	Redeveloping Abandoned Quarries for Community Parks – Central Minnesota. By J.D. Asp and J.M. Halter	Variation in fluvial geomorphic design input values, its effect on design performance, and emerging techniques for input value measurement. By N. Bugosh, J.F.M. Duque, and I. Zapico
9:00 a.m. - 9:30 a.m.	Keeping the Research Relevant. By W. Lee Daniels, S. Flath, B. Schladweiler, T.J. Toy, A.F. Wick	Planning, Removal, and Relocation of the Hibbing Mine for Mine Progression. By M.J. Bolf and A. Lucia	A Study of Coal Mine Overburden Support in Western Kentucky. By Clyde DeRossett

9:30 a.m. - 10:00 a.m.	Industry Applying Multiple Minds at the Mine. By S. Flath, W. Lee Daniels, B. Schladweiler, T.J. Toy, A.F. Wick	Laurentian Vision Partnership – Transforming Pits and Piles into Lakes and Landscapes. By James B. Plummer	Erosion and sediment control at surface coal mines of semi-arid environments. By A. Krzyszowska Waitkus
10:00 a.m. - 10:30 a.m. BREAK - Edmund Fitzgerald Hall			
WEDNESDAY, JUNE 10, TECHNICAL SESSIONS			
	Partnerships in Reclamation (cont'd) SESSION 8A - Gooseberry Falls Room 1 Moderator - Abbey Wick	International Case Studies SESSION 8B - Gooseberry Falls Room 2	Approaches to Data Collection SESSION 8C - Gooseberry Falls Room 3
10:30 a.m. - 11:00 a.m.	Consulting Approaches Considering Multiple Partners. By B. Schladweiler, W. Lee Daniels, S. Flath, T.J. Toy, A.F. Wick	Monitoring and analysis of the change and reuse of Abandoned Mine Land in Mentougou District, Beijing. By L.L. Cheng, Y. Zhang	Data Collection for the Conflict Around the Corner. By M. Glenn and K. Krogstad
11:00 a.m. - 11:30 a.m.	Extension Ain't Your Grandpa's Program Anymore. By A.F. Wick, W. Lee Daniels, S. Flath, B. Schladweiler, T.J. Toy	An integrated method to analysis coal mining impacts on ecological environment in a semi-arid area: A case study in northern China. By Wu Xiao, Xuejiao Lv, and Zhenqi Hu	Comparing Monitoring Data to a Moving Baseline. By Kevin Krogstad and Mike Glenn
11:30 a.m. - 12:00 p.m.	Partnerships in Reclamation. By A.F. Wick, W. Lee Daniels, S. Flath, B. Schladweiler, T.J. Toy Discussion to follow	On Land Reclamation Science. By Zhenqi Hu	Soils and Overburden plus Land Use TD Meetings
* indicates Student presentation			
12:00 P.M. - 1:30 P.M. - LUNCH AND STUDENT AWARDS – Lake Superior Ballroom			

Cultural Event #3 – North Shore Scenic Railroad Train Excursion - Wednesday 6/10 - 12:00-2:30 p.m.

Ride the Duluth Zephyr, which brings you through downtown Duluth, a little way up the North Shore, through Congdon Park, and to the neighborhood of Lakeside for spectacular lake viewing.



EPA-Hosted Panel Discussion - 2:00-4:00 French River Room

Legacy Mining Cleanup Technology Workshop: Identifying and Advancing the Use of Innovative Approaches

A facilitated discussion and workshop led by a panel of experts from Federal and state agencies and mining companies, site owners, and consultants on the remediation of abandoned and legacy mining sites and efforts to advance innovative technologies for characterization, cleanup, and monitoring. This participatory workshop will provide an introduction of technology needs and development efforts currently underway across sectors involved in mining remediation. The session will consist primarily of a panel and audience discussion on needs, available technologies, and strategies to advance innovation. The goal of the workshop will be to:

- Identify a common understanding of key areas of remediation needs in the characterization and cleanup of mining sites, including strategies for mine influenced waters, source contamination, tailings and other waste piles, mining-related processing facilities.
- Develop an initial inventory of promising technologies or approaches and the state of technology development.



- Identify key issues facing technology researchers and developers.
- Identify the performance information needs of technology users (regulators, site owners, consultants) to improve acceptance of new tools and approaches.
- Understand needs and media for information dissemination and training on innovative tools and approaches.

NEC Wrap-Up Meeting - 4:15-5:15 – Board Room

After Lunch: Self-Guided Field Trip - Duluth Stream Reconstruction

In 2012, Duluth experienced a two-day rainfall event that flooded the creeks running through Duluth's hillside and resulted in millions of dollars of infrastructure damage. Many of these creeks were subsequently restored and are some of the city's most beautiful features and are accessible by hiking trails. You will be able to follow along with maps and materials to take a look at these restoration projects. Get a guide from the registration desk. Allow 2+ hours.

5:30 P.M. - 9:00 P.M. - EARLY CAREER PROFESSIONAL EVENT: Hoops Bar

This event will bring together early career professionals and experienced professionals for valuable mentorship. The event will include food, beverages, and fun ways for early career professionals and mentors to interact.



Wednesday, June 10, 2020

Workshops 1:30 - 5:00 Gooseberry Falls Rooms

Mine Subsidence Workshop

The workshop will be broken down into a more in-depth study of land subsidence from the underground mining of coal. It will cover key aspects of mine subsidence, a subject that is not well understood, and embraces several engineering disciplines. The workshop focuses on the causes of mine subsidence and how mine stability relates to the resulting ground movements. Different mining and geologic conditions determine the mode of failure of the mine. The mode of mine failure in turn affects the resulting subsidence movement and consequently the resulting damage. Prediction of subsidence and damage potential and mitigation alternatives are also key aspects of subsidence engineering. Workshop outline consists of causation and risk of subsidence, subsidence movement, and the effect of these movements on structures and pipelines. Also, in the last portion of the workshop, subsidence mitigation alternatives will be discussed. After each section of the workshop, there will be a question and answer period. This workshop will be presented in a manner that will be understandable to anyone that would be interested in learning more about mine subsidence engineering. Handouts will be provided.

Dr. Gennaro G. Marino has a Ph.D. in Civil Engineering from the University of Illinois. His thesis involved mine subsidence and structural response over room and pillar mines. He

presently is a licensed P.E. in 27 states. He has authored numerous articles on subsidence and has received multiple awards for his work, expertise, ethics, and professional development. His work spanning over 40 years includes all aspects of subsidence engineering with government agencies, engineering and architectural firms, surface owners, pipeline, insurance, and mining companies, including planning, mining, and abandonment stages of room and pillar to high extraction workings, and cause and origin investigations.

GeoFluv Approach to Fluvial Geomorphic Reclamation Workshop

Fluvial geomorphic landform design has become recognized globally as a reclamation best practice. Functional fluvial geomorphic design is more than just bending contours to 'look natural' and this workshop will explain how to design fluvial geomorphic reclamation correctly to get the desired results. Participants will get an overview of the geomorphic elements that comprise functional reclamation landform design and an explanation of how these elements are measured from reference areas for design input. We will discuss common errors that are made in the design and construction of fluvial geomorphic reclamation projects. How a multi-year quantitative study documented sediment yield comparable to adjacent undisturbed natural land in the most erosive environments was used to validate constructed reclamation performance will be presented. GeoFluv is a patented reclamation landform design method that is the basis for the Natural Regrade CAD software that helps designers make these complex designs efficiently. Participants

will have the opportunity to apply these concepts to make a fluvial geomorphic design for a stream channel and a waste dump landform using the Natural Regrade CAD software.

Nicholas Bugosh is the inventor of GeoFluv upon which Natural Regrade is based (OSM TIPS core software). He has conducted field research on bedload transportation, worked for numerous state agencies, and with mining and water quality regulation, been a hydrologic consultant on projects across the U.S., and was Senior Hydrologist for the largest mining company in the world. His fluvial geomorphic method has received numerous awards and has been recognized by U.S. states and the European Union as Best Technology Currently Available. He formed the company GeoFluv in to provide training, coaching, and consulting services in his method and he is the GeoFluv Technical Director for Carlson Software.

Thursday, June 11, 2020

Breakfast on Your Own

8:00 a.m. – 5:00 p.m. ... Professional Tour #3: Peat Mining and Reclamation.

For more information see: <https://www.asmr.us/Meetings/2020-Annual-Meeting/Special-Events>

Peat Mining and Reclamation (full day)



This tour heads south and west out of Duluth to visit active peat mining sites that undergo progressive wetland reclamation. We'll see the novel harvesting equipment and bagging operations along with reclaimed wetland sites at the Premier Peat and American Peat Technology sites. We'll also have lunch in Tamarack, where Talon Metals has been actively exploring a high-grade Cu/Ni+PGE deposit. Last, we'll stop to look at some unique geology and beautiful views at Jay Cooke State Park, located just west of Duluth.

9:00 a.m. - 11:30 Professional Tour #4. Estuary Restoration Boat Tour.

For more information see: <https://www.asmr.us/Meetings/2020-Annual-Meeting/Special-Events>

Estuary Restoration Boat Tour (~2 hours)



The St. Louis River flows into western Lake Superior to create one of the most remarkable coastal systems on the Great Lakes: the St. Louis estuary and harbor. This boat excursion will highlight several of the remediation and restoration projects taking place within the estuary. These projects are part of the St. Louis River Area of Concern, a series of management activities and projects with partial funding through the Great Lakes Restoration Initiative to address several beneficial use impairments within the harbor and river corridor. Projects have included sediment capping and habitat improvements supporting fish and bird populations.

2020 ASMR KEY NOTE SPEAKERS

Remediation, Restoration, and Revitalization in the St. Louis River Area of Concern



Melissa Sjolund is part of Minnesota Department of Natural Resources St. Louis River Restoration Initiative and serves as the agency's Area of Concern Coordinator. She has participated in past ASMR conferences, first as a Montana State University graduate student in Land Rehabilitation, and later as a consultant in oil and gas field reclamation and permitting specialist for the Montana Department of Environmental Quality's Coal Program. Since relocating to Duluth three and a half years ago, Melissa has been working hard with the Area of Concern team to remove the St. Louis River from an international list of degraded waterbodies.



Dan Powell is the Chief of the Technology Integration and Information Branch in the Headquarters Superfund program at the U.S. EPA's Office of Land and Emergency Management. In this capacity, he leads efforts to promote awareness and use of best practices and innovative technologies for site clean-up at hazardous waste sites. Dan has over 30 years of experience in Superfund and waste site cleanup, he has been with the Technology Innovation Program, now part of the Office of Superfund Remediation and Technology Innovation, since 1990, and has served as a Branch Chief for 14 years. Dan came to the Agency in 1988 as a Presidential Management

Intern with Office of Solid Waste and Emergency Response and has worked in the program budget and information management offices; the Office of Underground Storage Tanks; the Region 4 Superfund Program; and the Congressional Office of Rep. Michael Bilirakis (FL). Dan received his MA in Public Administration from the Woodrow Wilson School of Government at the University of Virginia in 1988, and graduated summa cum laude as the class Valedictorian with his BA degree as a double-major in political science and urban studies from Roanoke College (Salem, VA) in 1985.

TUESDAY LUNCH SPEAKER



Ancient Industry: Archaic Copper Mining in the Upper Great Lakes

Ryan Edward Peterson is a PhD student at Indiana University, where he specializes in Great Lakes Archaeology, works as an Associate Instructor, and helps with the rehousing and relocation of the Angel Mounds collection. The primary focus of his research is the extraction, production, and exchange of native copper in the Upper Great Lakes over 4,000 years ago. Ryan's work has inspired him to carry out research throughout the Upper Great Lakes, conducting archaeological excavations and surveys along numerous shorelines and islands in Lake Superior and Lake Michigan.

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JUNE 6-10, 2021



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Gold Rush Gone Red: A History of Iron Mining in Minnesota



By Kelsey Johnson, President, Iron Mining Association of Minnesota

“The eye takes in a score or more graceful promontories, capes and peninsulas, — running their moss and pine covered points down into the Lake, as if to cool their metallic palates already burning to be unbosomed by the restless hands of enterprising miners... The gold fields in this section will probably be full of enterprising miners; and Vermilion City, at the Falls on the South Vermilion River, be peopled by a population not less than ten thousand.”

— Ossian E. Dodge, 1865

When Ossian E. Dodge wrote these words in the St. Paul Pioneer during the fall of 1865, he was correct about a few things: the natural beauty of northern Minnesota was breathtaking; miners would flock to the region; and mining would indeed lead the population to surge. However, unbeknownst to Dodge or the general population at the time, the real success of the industry would not be from gold; it would be from the region's deep-running veins of iron ore.



Photo 1: Location of the Vermilion, Mesabi and Cuyuna iron ranges in northern Minnesota (Mnopedia.org)

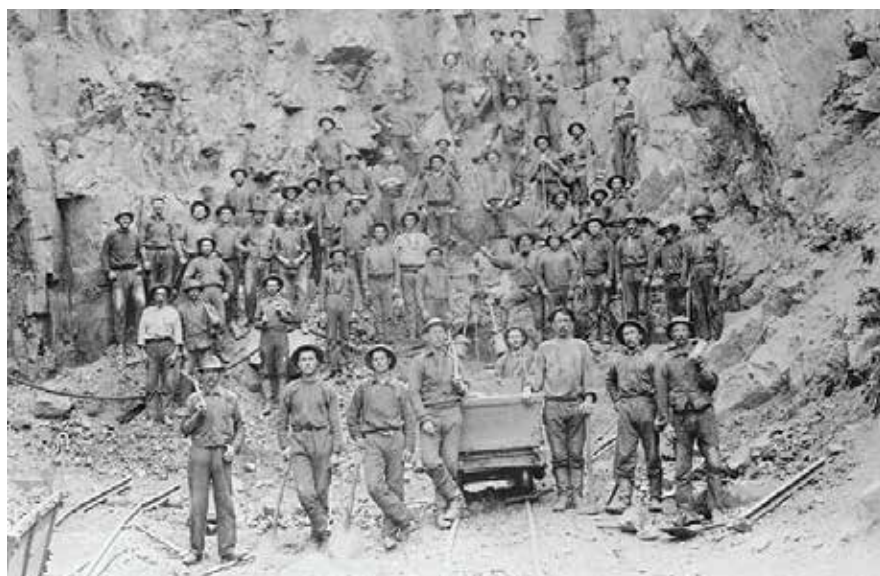


Photo 2: Minnesota's first iron mine opened at Tower-Soudan in 1884. This picture was taken in 1890 before the mine was converted from open pit to underground. (Taconite.org).

Beginning in the mid-19th century, the possible mineral wealth of Minnesota's northeastern region intrigued early northern pioneers. Initially, indications of copper led prospectors up the St. Louis River. In 1865, geologist H. H. Eames and his team journeyed north, paddling the bays of Lake Vermilion and Fond Du Lac River in a birchbark canoe. On their return, they presented samples of superior quality iron ore, as well as specimens of gold-bearing quartz.

In an instant, excitement for the region exploded—but not because of the iron. Publications across the country shared the news of Minnesota's extensive gold deposits and a stampede of eager prospectors rushed toward the nation's new gold opportunities. Companies

were created, thousands of dollars of capital were invested, and valuable machinery was shipped to the sites. Importantly, the rush of people, supplies and money to the Vermilion Range led to the cutting of the first road heading north of Duluth, Minnesota.

George R. Stuntz, a Pennsylvanian who had come to Minnesota as a land surveyor in the 1850s, was likely one of the region's first gold prospectors. In his personal narrative, he described the boom and bust of the Minnesota gold rush:

“Did they find any gold? Not that I ever heard of. There were thousands of men scattered over the range for a year or so, prospecting, but finally the excitement died out.”



Photo 3: Open pit iron mining in the Mesabi Iron Range. (ss.sites.mtu.edu, commons.wikimedia.org)

The fact is, there was gold, but not enough to pay. While Stuntz's gold prospect proved unsuccessful, his exploration brought light to the region's red-toned mineral that, until this point, had been greatly overlooked. Stuntz had first heard of Vermilion's iron ore deposits third-hand in 1863, a tip that came from the Bois Forte Band of Chippewa. While Stuntz had not considered this information critical at the time, seeing the deposits for himself destined his opinion to change. In his narrative, Stuntz recalled his change of heart:

"I saw the location, at the east end of the bluff, where it showed the richest, and where I got the specimens that finally called the attention of the capitalists to that part of the country."

Stuntz also famously stated, "When this country is developed, that big mountain of iron will do it. When they get to hauling that iron out, they will haul in its supplies cheap."

While the scores of iron ore hidden beneath the Vermilion Range would lie untouched for another nearly two decades, the disappointing gold rush had led to one important change in the region: a road providing accessibility to the land under which the ore was buried.

Throughout the late 1870s, further exploration was conducted on the Vermilion and the Mesabi Ranges, located near Lake Vermilion (Photo 1). Rumors of a mountain made of solid iron and enticing samples of the rock had led eastern capitalists to grow interested in the potential of Minnesota's iron mining industry. It was through such capitalists that George Stone, one of the major supporters of early Minnesota mining, was rumored to come home from a trip to Philadelphia with "a check for \$50,000 tucked in his pocket" and a commission to proceed at once with the preliminary plans necessary for opening a mine at Lake Vermilion on a large scale. Whether this is exactly true or not, it is confirmed that Stone devoted years of his life to develop the Vermilion Range.

In 1882, a small crew of men began to test putting mines on the Vermilion Range. In their first winter in Soudan at one of the initial mines, miners suffered a frigid winter with minimal comforts, only eating cans of beans and tomatoes. However, this group had a lucky break when they found an old steam boiler, brought to the site during the gold rush, and used it as a stove.

The small crew's test work and struggles paid off. In December, the Minnesota Iron Mining Company was formed surrounding the Soudan area. After a lapse of two decades, the Minnesota mining industry flourished again—and this time, in a lasting way. The new iron mining industry built on a solid base of mineral deposits and grew with the infrastructure and means to succeed. Once again, miners flocked north.

July 31st, 1884 marked a momentous day for the Vermilion Range and Minnesota's iron mining industry, as

a train first arrived at Soudan via a newly completed railroad connecting the Soudan Mine with Two Harbors, located east on Lake Superior. Elisha Morcom Jr. said of the day:

"All the men of the mines had a half holiday in celebration of the completion of the railroad. The Indians came in from the forest and helped the celebration along with a big 'pow-wow.' The men all got busy and shipped five cars containing one hundred tons of ore on the same day."

Over the course of the next 10 years, iron ore shipments from Soudan to Two Harbors continued to grow, through 1892, in which more than 1 million tons journeyed east via rail (Photo 2). And while the quantity of iron ore was impressive, it's been said that the quality is what made it famous. After the immensely successful outset of the Soudan Mine on the Vermilion Range, it didn't take long for more mines to begin blasting the vast stores of iron ore across northeastern Minnesota.

Following the Vermilion Range, the Mesabi Range's first shipment of iron ore was in 1892, followed by the Cuyana Range's first shipment in 1911. Through the first half of the 20th century, the mines of these ranges led Minnesota to produce more than 80 percent of iron ore in the United States (Photo 3).

While the Soudan Mine and the majority of mines on the Vermilion and Cuyana Ranges stopped operation in the 1960s, mining continues to this day on the Mesabi Range. The initial burst of activity in the region in the late 19th and early 20th centuries led to the settlements of approximately 75 separate Minnesota townsites that would otherwise not



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Photo 4: Taconite mining continues in the Mesabi Iron Range today.

exist. The city of Tower, the location of the Soudan Mine, had the honor of being the first Minnesota city located north of Duluth. Lake Vermilion, where prospectors first flocked for gold and then paddled to iron ore deposits, is now a beloved tourist destination, thanks to the infrastructure brought on by iron mining. Additionally, the Lake Vermilion-Soudan Underground Mine State Park offers visitors the chance to experience the early days of iron mining. Wearing a hard hat and travelling a half-mile below the Earth's surface for a guided tour of the former mine at Soudan, visitors experience what the first iron miner's daily experience was like.

The Mesabi Range still holds valuable

taconite deposits with active mining operations taking place to this day (Photos 4 and 5). Minnesota currently has six active taconite mines along the Mesabi Range. The iron mining industry in Minnesota contributes over \$3 billion to Minnesota's economy each year, while providing over 16,000 high-skill, family supporting jobs in the state. Minnesota currently produces approximately 90 percent of the nation's iron, providing the steel citizens use every day—whether driving to work or doing the laundry.

Minnesota's gold rush didn't last. But it led to the development of the previously untouched northern edge of the state and taught us that, sometimes, red iron is more valuable than gold. ■



Photo 5: Reclamation of iron ore surface mines includes revegetation with grasses, flowers and trees (shown in the background).

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Bur Oak Coppice Regrowth on a Reclaimed Coal Mine in Eastern Canada

By A. Mosser¹, J.E. Major², and D. McPhee³

Natural Resources Canada, Canadian Forest Service - Atlantic Forestry Centre

This article was previously published in the Fall/Winter 2019 issue of *Canadian Reclamation*.

Background

Coppicing is an ancient form of forest management that relies on regeneration from stem sprouting at the root collar following the removal of aboveground biomass. Under natural conditions, coppice stem regrowth often occurs following natural or artificial disturbances, such as fire, wildlife browsing, or forest harvesting. This method of forest regeneration fell into disuse and disrepute across much of Europe during the 1800s largely because professional foresters believed that coppicing produced poor quality stems for timber production. Although coppicing of upland hardwoods has not been prominent in North American silviculture, it has been used for oak management in the southern Appalachian Mountains, where early, rapid height growth from coppicing stump sprouts confers a competitive height growth advantage over artificially established seedlings. In China, coppicing has been an important forest management tool for several native oak species in mountainous terrain. Given the increasing concern about the effects of climate warming and associated drought stress on the success of both natural and artificial forest regeneration, and the survival of oak forests on drought-prone sites in particular, silvicultural systems based on coppicing may become more important in maintaining oaks at the limits of their drought tolerance.

In North America, bur oak (*Quercus macrocarpa* Michx.) is predominantly a temperate zone species ranging from southern Saskatchewan to a geographically disjunct population in southeastern New Brunswick (NB) and across the central and eastern USA, reaching as far south as Texas. In Canada,



Planting Bur Oak seedlings at the former Salmon Harbour coal mine in New Brunswick.

bur oak occurs under a wide range of soil fertility and moisture conditions, but at the northeastern limit of its range, it can be found on shallow, droughty soils. The putative drought-tolerance of bur oak suggested that it might be a useful species for reclaiming large areas of highly disturbed shale coal mine spoils covering hundreds of square kilometres in southern NB.

In 2015, 10 blocks of 25 bur oak saplings, planted as seedlings in 2006, were separated into five different site type groups based on physical proximity and similarity of the site types in order to test for the effects of site differences on growth of the 10-year-old saplings prior to harvesting, and the subsequent coppice regrowth traits of the resulting one- and two-year-old coppiced plants. The shale rock overburden at the former Salmon Harbour coal mine site is characterized by low fertility, a lack of organic matter, and low nitrogen (N) content. Soil samples were collected from each of the five site type groupings

for a soil analysis (Table 1, Figure 1). Soil properties were reasonably uniform, apart from the proportions of sand, silt, and clay, which showed statistically significant, but not large, differences from one site to another. The main distinguishing feature was the higher nitrogen content on site five, which was almost twice as great as that found on the other four sites. Soil and site characteristics can influence growth, stem-sprouting ability, and coppice formation in oaks, although most oak species generally sprout vigorously following burning or cutting of smaller saplings or trees in southern Appalachian forests. We were interested in how site variability on such infertile shale overburden might affect stem sprouting and coppice regrowth in one- and two-year-old coppices following harvesting of 10-year-old saplings of bur oak. Our aim was to quantify variation in coppicing response in terms of stem height growth, coppice stem number and biomass yield, and to test the effect of site and soil variability on coppice formation.

Seeds for the bur oak planted on the Salmon Harbour coal mine spoils were collected from 21 trees, representing seven of the eight remaining bur oak stands in NB. The germinated acorns were transplanted to containers and planted on the mine site in June 2006 (see map in Figure 1). Seedlings were established at approximately five-metre spacing, but planting microsites were selected based on quality of the planting site rather than a predetermined planting grid. Seedling survival was assessed two years after planting and was very high at almost 99 percent. In their tenth growing season following establishment, 10 seedlings from each 25-tree group were randomly selected and harvested. The number of stems was counted, and the dominant stem per sapling was measured for height and diameter, and the weight of the leafless aboveground green mass was measured. A single 20-centimetre stem section removed from the centroid of the dominant stem from each of the ten harvested saplings in each of the 10 groups of 25 seedlings was weighed to obtain the green mass and to determine percent moisture content following oven drying in order to calculate oven-dry woody biomass. After leaf fall in November 2016 (one-year-old coppice) and again in 2017 (two-year-old coppice), the number of coppice stems arising from the root collar was counted on five randomly selected coppiced plants from each of the 10 25-tree groups, and the green weight of the coppiced stems was weighed to the nearest 1.0 g. The height and stem basal diameter of up to six of the tallest coppice



Planted Bur Oak seedlings on the treeless barrens of the former Salmon Harbour coal mine in New Brunswick.



Planting on the compacted, shale rock mine spoils of a former coal mine.

stems were measured, and both the green and oven-dry biomass were determined. Biomass traits (e.g., stem height, stem basal diameter, coppice stem number, and oven-dry weight of aboveground leafless plant biomass) were subjected to analysis of variance (ANOVA).

Results

The greatest stem height per plant showed significant differences among the three plant forms (10-year-old saplings, and one- and two-year-old coppices), and the stem height of two-year-old

TABLE 1. SOIL PROPERTIES FOR THE FIVE SITE TYPES AT SALMON HARBOUR COAL MINE.
SITES WITH DIFFERENT LETTERS ARE SIGNIFICANTLY DIFFERENT USING TUKEY'S MEAN SEPARATION TEST, $P = 0.05$

Site	Organic matter (%)	Carbon (%)	Nitrogen (%)	Potassium meq 100 g ⁻¹	Calcium meq 100 g ⁻¹	Magnesium meq 100 g ⁻¹	Phosphorus (ppm)
1	1.05 ± 0.13 a	0.61 ± 0.08 a	0.071 ± 0.010 b	0.166 ± 0.020 a	5.05 ± 1.06 a	0.64 ± 0.12 a	3.68 ± 1.10 a
2	1.21 ± 0.13 a	0.70 ± 0.08 a	0.060 ± 0.017 b	0.141 ± 0.020 a	6.62 ± 1.06 a	0.65 ± 0.12 a	3.85 ± 1.10 a
3	1.22 ± 0.13 a	0.71 ± 0.08 a	0.063 ± 0.010 b	0.178 ± 0.020 a	5.77 ± 1.06 a	0.75 ± 0.12 a	4.20 ± 1.10 a
4	1.16 ± 0.13 a	0.68 ± 0.08 a	0.063 ± 0.010 b	0.210 ± 0.020 a	7.27 ± 1.06 a	0.87 ± 0.12 a	3.11 ± 1.10 a
5	1.14 ± 0.13 a	0.66 ± 0.08 a	0.123 ± 0.010 a	0.200 ± 0.020 a	5.96 ± 1.06 a	0.68 ± 0.12 a	2.98 ± 1.10 a
Site	Sand (%)	Silt (%)	Clay (%)	pH	C:N ratio	Sulfur (%)	Sodium
1	57.1 ± 2.3 a	28.4 ± 2.3 ab	14.4 ± 1.0 bc	6.1 ± 0.8 a	9.1 ± 1.7 a	0.114 ± 0.023 a	0.031 ± 0.008 a
2	61.4 ± 2.3 a	27.3 ± 2.3 b	11.3 ± 1.0 c	6.9 ± 0.8 a	7.9 ± 1.7 a	0.074 ± 0.023 a	0.010 ± 0.008 a
3	46.5 ± 2.3 bc	37.3 ± 2.3 ab	16.1 ± 1.0 b	5.8 ± 0.8 a	11.3 ± 1.7 a	0.064 ± 0.023 a	0.021 ± 0.008 a
4	41.4 ± 2.3 c	38.4 ± 2.3 a	20.5 ± 1.0 a	5.8 ± 0.8 a	9.8 ± 1.7 a	0.100 ± 0.023 a	0.019 ± 0.008 a
5	53.5 ± 2.3 ab	29.8 ± 2.3 ab	16.7 ± 1.0 ab	6.2 ± 0.8 a	5.4 ± 1.7 a	0.088 ± 0.023 a	0.025 ± 0.008 a



Typical, multi-stemmed one-year-old coppices of Bur Oak arising following harvesting of 10-year-old saplings



*Ten-year-old saplings of Bur Oak (left) and a two-year-old coppice plant (right) that arose following harvesting of the ten-year-old saplings, together with pitch pine (*Pinus rigida*) in the background, on the former Salmon Harbour coal mine in New Brunswick.*



Multi-stemmed two-year-old coppices of Bur Oak arising from harvested 10-year-old saplings.

coppices was 20 percent greater than the 10-year-old saplings (Figure 2). Site type had a significant impact on height growth but this was largely due to the greater stem height on site five, which was 138 centimetres vs. the average of 93 centimetres for the other four sites (a 50 percent greater stem height) and had almost twice the nitrogen content in the soil. The two-year-old coppice stem height was consistently greater than the height of the 10-year-old saplings on all sites.

The 10-year-old saplings and two-year-old coppices were virtually equal in aboveground dry mass at 214 and 207 g, respectively (Figure 3). The N-rich site five had 2.3 times the productivity of the average of the other four sites. Although

the 10-year-old saplings had greater aboveground dry mass than two-year-old coppices on site five, on the other four sites, the two-year-old coppices had aboveground dry mass greater than, or equal to, that of the 10-year-old saplings. Plant form had overwhelmingly the greatest effect on total variation in stem number, with stem numbers being 1.2, 7.3, and 6.2 for 10-year-old saplings and one- and two-year-old coppices (Figure 3), respectively.

The most dramatic result of this bur oak coppicing experiment was the rapid recovery of height growth, biomass production, and observable stem quality in coppices over the two-year period following harvesting of the original 10-year-old saplings. Contrary to expectations, coppices were observed to have a straighter and more upright stem form than that of the often misshapen and twisted single-stemmed 10-year-old saplings. If stem numbers and the observable stem quality resulting from coppicing are maintained into the future, the coppiced plant structure could result in a fuller and more spreading tree crown and canopy structure for wildlife and result in improved stem quality for timber and bioenergy production. The coppice stems may have benefited from some interstem competition, as indicated by the mildly positive effect of coppicing on height growth.

Plants require nitrogen more than any other nutrient. The positive effect of increased soil nitrogen on plant productivity globally has been well known in the literature. This bur oak experiment

was established on sites where the soil nitrogen values were below 0.1 percent on four of five sites tested. By assessing a number of key soil macronutrients, our study demonstrated the positive effects associated with nitrogen on tree growth, especially on impoverished sites, where it appears that this nitrogen difference resulted in a 2.3-fold increase in aboveground biomass growth.

The young bur oak coppices in our study showed beneficial effects on tree structure following coppicing. How long this beneficial effect maintains itself is uncertain. Potentially damaging wind exposure and drought conditions on such exposed, infertile, treeless barrens can result in initial slow growth and misshapen stems, as observed in the 10-year-old saplings. Harvesting and coppicing bur oak saplings at younger ages of 10 years or less appears useful in improving tree morphology and structure, either for timber quality or perhaps in shorter harvest rotations for bioenergy. The bur oak in our study responded well to coppicing, resulting in rapid recovery of woody biomass volume on young, slow-growing trees in which growth had been adversely affected by poor growing conditions and site exposure. Therefore, we recommend coppicing as a means of revitalizing or rejuvenating young trees or saplings whose growth and form may have deteriorated under the harsh growing conditions associated with former mining operations.

Oak forests appear to be in decline globally, most probably due to changing conditions with respect to drought



Figure 1. Map showing the location of 10 groups (blocks) of 25 bur oak saplings organized into five site types (e.g., site 1 consists of groups 1-1 and 1-2, site 2 consists of groups 2-1 and 2-2, etc.) established at the former Salmon Harbour coal mine near Minto, New Brunswick, Canada.

as climates become warmer. In many areas, it has been difficult to restore oak forests under natural conditions using conventional forest management approaches due to drought, herbivory, and/or vegetative competition. Furthermore, doubts about the ability

of older and larger oak stems to sprout vigorously following stem harvesting may have prevented a more widespread adoption of coppice management in many parts of the world. However, the younger bur oak saplings in our study have shown promising coppice regrowth following harvesting. On this highly disturbed former coal mine site, bur oak showed excellent survival up to age 10, but these seedlings grew slowly, probably due to the exposed site conditions. Harvesting such poorly growing saplings at a young age appeared useful for promoting good-quality, coppice regrowth.

Coppicing appears to be an effective way to rejuvenate poorly formed, slow-growing stems on highly disturbed, infertile, exposed areas such as the treeless barrens of former mine sites. On drought-prone sites, coppicing in combination with shorter harvest cycles/rotations may be effective in maintaining oak populations because coppicing takes advantage of an established root system as opposed to

re-establishing species by planting seedlings that may be more susceptible to drought following planting. ■

Acknowledgments

We gratefully acknowledge the assistance of Ian DeMerchant for preparing the map in Fig. 1 and Michele Coleman, Environment Engineer, with NBPowr for logistical support on site.

Background literature

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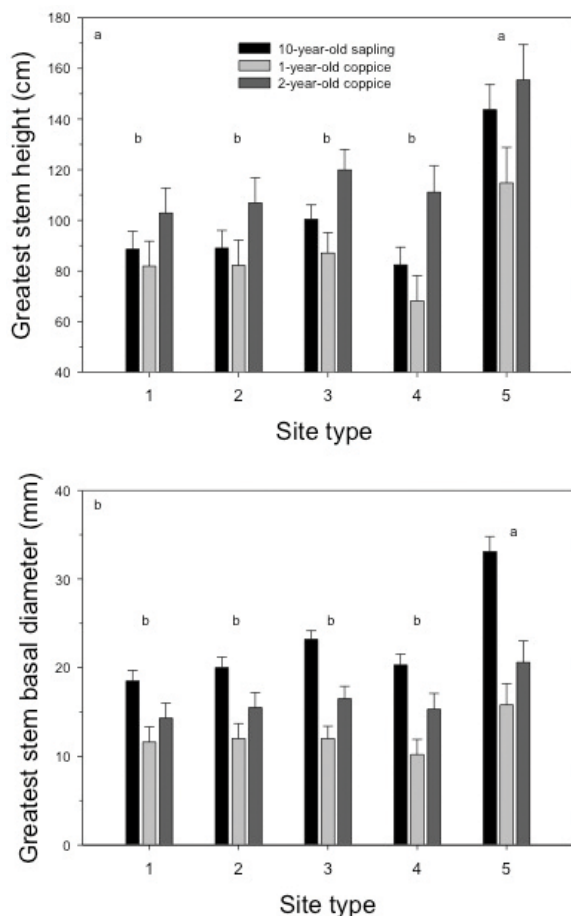


Figure 2. Greatest stem height (cm) and stem diameter (mm) by site type and plant form.

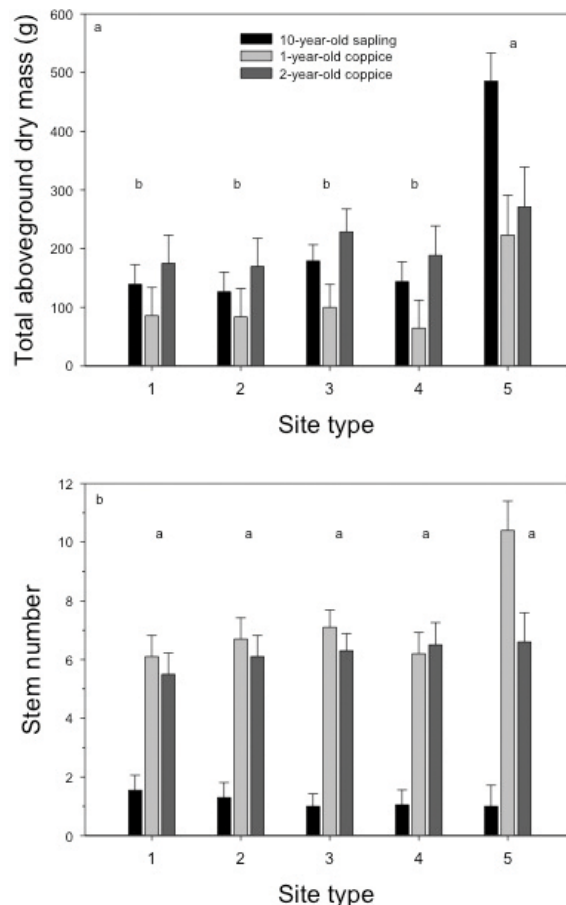


Figure 3. Total aboveground dry mass and stem number, by site type and plant form.

MINNESOTA: Land of 10,000 Lakes and Seven Million Acres of Peat!

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Minnesota is known as lake country (it's even on our license plates) but there is more than twice the area of peatlands as lakes (7 million vs 2.6 million acres). In the early 1980s, when peat was being evaluated as a potential fuel source, former Governor Rudy Perpich declared Minnesota as “the Saudi Arabia of Peat.” According to the United State Geologic Survey (2019), Minnesota is one of the leading producers of peat, second only to Alaska in total acres of peatland. In 2018, Minnesota companies harvested about 385,000 cubic yards of peat.

What is Peat?

Peat is partially decomposed plant remains that accumulate under anaerobic, water-logged conditions. It generally forms in areas where precipitation exceeds evapotranspiration. Minnesota's peatlands can be divided into two types (Figure 1): bogs and fens (MnDNR.org). Bog characteristics include acidic conditions, moisture input from precipitation only, an elevated dense peat surface, Sphagnum moss, and stunted black spruce trees. Fens are more basic – fed by groundwater flowing up through mineral soils, they contain sedges and other grass-like plants, shrubs, and tamarack trees. Both bogs and fens can be either open or forested.



Figure 1. Moisture infiltration into Bogs and Fens.
<https://www.dnr.state.mn.us/snas/peatlands.html>

Why is it in Minnesota?

Distribution of peat in Minnesota is tied to glacial advances that began about 75,000 years ago (Figures 2 and 3). Receding ice sheets (12,000 years ago) left behind areas with topographic and geomorphic features favorable for the development of peat. Landforms and glacial features such as glacial lakes and outwash

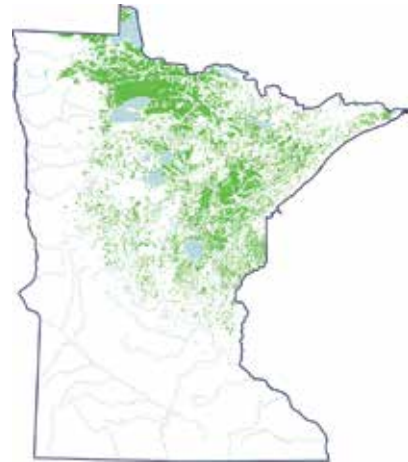


Figure 2. Distribution of Minnesota Peatlands
<https://www.dnr.state.mn.us/snas/peatlands.html>

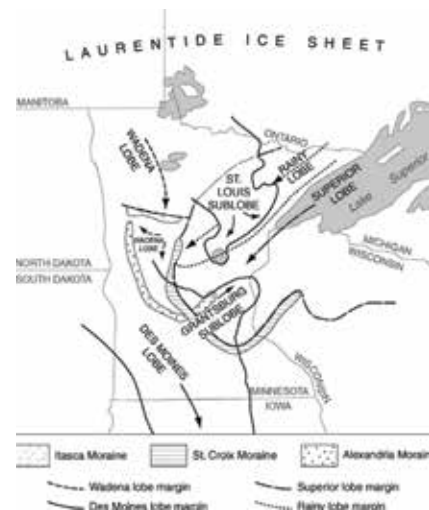


Figure 3. Glacial advances in Minnesota
Patterson, C. J., and Johnson, M.D., 2004

plains provided areas of depressions and impermeable soils that allow ponding and slow water movement (Olson et al, 1979). This combination provided a favorable environment for peat development. Current peat mining occurs in areas that were once large shallow glacial lakes that deposited poorly draining soils.

Types of Peat

Peat is classified according to its botanical origin and degree of decomposition. Two common types occurring in Minnesota are Sphagnum moss peat and reed-sedge peat. Sphagnum peat originates from Sphagnum moss, tends to be more acidic and fibrous, and is generally found at the top of peat deposits (Photo 1). Reed-sedge peat develops from reeds and sedges and tends to be more decomposed, less fibrous, and less acidic (Photo 2). It generally occurs below the sphagnum layer.



Photo 1. Sphagnum moss peat



Photo 2. Reed-sedge peat

Uses of Peat

Peat is probably best known as a soil amendment that is frequently used in gardens, golf courses, athletic fields, and various landscape projects. It is also a major component of greenhouse and nursery growing media. It is prized for its water and nutrient-holding capacity, ability to aerate or loosen heavy soils, and its consistent product quality. Peat is sold in bulk, compressed bales, and loose-filled bags easily found in your local hardware store or nursery. Although peat is not used as a fuel in Minnesota, countries like Finland and Ireland still use it for that purpose.

However, peat also has other uses. It possesses a natural ability to remove metals from water; it provides a suitable surface for beneficial bacteria (Rhizobium) that increase nitrogen fixation in agricultural fields, is used in therapeutic “peat baths,” as an oil absorbent, and even makes “a heck of a whiskey.”

Peat Harvesting

Currently there are 10 peat-harvesting operations in Minnesota mining on about 2,200 acres. All but one uses a vacuum harvester, which looks like an enormous tractor-pulled vacuum cleaner (Photo 3).



Photo 3. Peat harvesting Premier Horticulture, Cromwell, Minnesota.

Since peatlands are inherently wet, the area must be ditched to remove water to provide a surface that will support low ground pressure vehicles.

Once the top surface is dry, the peat is disked to loosen the peat and exposed to summer drying conditions. The peat is periodically turned with a harrow, and when suitably dry, the material is harvested with a vacuum harvester. The peat is then screened and bagged (Photo 4).



Photo 4. Bagged Peat Moss at Premier Horticulture

For horticultural uses, only the top portion of the peat profile is harvested, since the deeper peat is more decomposed and not as desirable as a soil amendment. Over time, it also becomes increasingly difficult to drain the water out of the peatland.

American Peat Technologies (APT) uses a different harvesting method and targets different markets. Currently most of the harvest is done during the winter using an excavator. The excavator sits on a frozen bank and removes the entire profile (Photo 5). The peat is hauled to the processing plant on ice roads built across the peatland.



Photo 5. Winter harvest of peat at APT

APT makes a granulated product from reed-sedge peat (Photo 6), which is used as a microbial carrier and to remove suspended and dissolved metals from various industrial waters, including mining (Eger and others, 2016). They are also currently working with a local distillery to produce a home-grown Minnesota peated whiskey (Burkhardt, 2019).



Photo 6. APT granulated peat

Restoration

Peat harvesting is regulated by the Minnesota Department of Natural Resources, U.S. Army Corps of Engineers, and Minnesota Pollution Control Agency. Every operation must restore the area they disturb and return the land to a functioning wetland.

Researchers at University of Minnesota Duluth's Natural Resources Research Institute have been studying peatland restoration methods since the 1990s. Although a variety of restoration methods have been tried, the most successful has been the "Canadian Approach." With this method, live donor vegetation (primarily Sphagnum moss) is collected from a nearby

natural site and spread over the mined peat surface. Only the top three to four inches is removed from the donor site to allow it to regenerate. This is followed with a straw mulch and blocking the drainage ditches. Fully restored ground cover to a layer of native Sphagnum mosses and associated peatland plants usually occurs in approximately five to 10 years. Premier Horticulture has had very good success with this method in Canada and Minnesota (Photo 7).



Photo 7. Restored peat mining area at Premier Horticulture, Cromwell, Minnesota.

APT is currently the only peat producer that uses full profile excavation and has been experimenting with various restoration approaches. These have included the use of native seed mixes, wild rice, live stakes, and donor soil. Testing is still in progress, but donor soil application has been very successful in establishing cover on the banks of the excavation pond.

Summary

Peat is a unique natural resource and Minnesota provides an opportunity to visit active operations and see successful restoration. Join us on the June 10th field trip for an up-close and personal experience with Minnesota's peatlands. ■

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