Wild Ones®

NATIVE PLANTS, NATURAL LANDSCAPES

OZARK CHAPTER

Winter 2023 **JOURNAL** Vol 4 - No 1

A VOICE FOR THE NATURAL LANDSCAPING MOVEMENT

Wild Ones
NATIVE PLANTS, NATURAL LANDSCAPES
OZARK CHAPTER
Est. 2019

Promoting environmentally sound landscaping practices to preserve biodiversity through the preservation, restoration and establishment of native plant communities.

Executive Board Officers

Pam Morgan, President
pk2morgan@gmail.com

Roslyn Imrie, Vice President
mailto:rozygrace@gmail.com

Shonda Garrison, Secretary
mhnativenursery@gmail.comv

Eric Fuselier, Treasurer
efuselier@olsson.com

Scott Biehle, Membership Chair
biehle@uark.edu

Established in 1977, Wild Ones is a national not-for-profit organization of members who teach the benefits of growing native plants while working together to grow and restore natural landscapes.

Wild One's definition of a native plant: A native plant is a species that occurs naturally in a particular region, ecosystem and/or habitat and was present prior to European settlement.

PRESIDENT'S COLUMN

Wild Ones,

Hello! I am thrilled to be serving as the new president of Wild Ones Ozark Chapter this year, and I'm excited to be joined by an impressive group of native plant experts and enthusiasts who are stepping up to serve on our board. It's going to be a great year for Wild Ones!

For those of you who I haven't met yet, here's a little about me. I moved to NW Arkansas, specifically Bentonvillle, about a year and a half ago from Connecticut, where I was a member of the Wild Ones Mountain Laurel Chapter. In Connecticut, I converted most of my ½-acre lawn to native plants, and once I saw all the bees, butterflies, and other wildlife thriving in my little yard, I was hooked! My background is in marketing, and I'm hoping to use my skills to further the mission of Wild Ones and get more native plants into people's yards and public landscapes.

My theme for 2023 is GROWTH, for you and for the chapter. If you planted some native plants this past year, hopefully those plants are growing well and you're thinking about how you can grow the number of native plants in your landscape. Wild Ones is here to help! We have another great slate of monthly educational programs and field trips lined up, and we're moving them to Saturdays to make them accessible to more people.

Right now the chapter has about 85 members, which is impressive considering it was founded just 3 years ago. I bet we can double that number this year! You can help us grow by talking to your friends, family, and neighbors about your experiences with native plants. Invite them to our programs, which are always free and open to the public.

If you have other ideas of how we can grow or how Wild Ones can serve you better, feel free to reach out. My personal email is pk2morgan@gmail.com. I look forward to being your president in 2023!

Pam Morgan, President
Wild Ones Ozark Chapter

CONTENTS

INTRODUCING Wild Ones NATIVE PLANTS, NATURAL LANDSCAPES OZARK CHAPTER 2023 EXECUTIVE BOARD OFFICERS

Pam Morgan - President

Pam served as our chapter Vice President in 2022 and is now ready to step up into the role of chapter President. Pam has already made a lot of great contributions to our chapter, such as creating the collectible native plant trading cards and helping organize our inaugural native seed swap. Originally from Connecticut where she was a member of Wild Ones' Mountain Laurel Chapter, Pam spent about 8 years converting her 0.5-acre lawn into a mostly native yard. Pam's professional background is in business and marketing. She has an MBA and was a marketing manager at Kodak for 15 years, a position she left to move to Northwest Arkansas. Pam has a wealth of experience in marketing and general business strategy. She has also spent a lot of time working with nonprofits, and in recruiting and organizing volunteers. Combined with her passion for wildlife and native plants, Pam is hoping to use her skills and experience to help Wild Ones further its mission here in NWA.

Roslyn Imrie – Vice President

Roslyn Imrie is the Director of Education and Community Outreach at the Botanical Garden of the Ozarks. She grew up in the wilderness of the Ozarks Mountains and has been cultivating a relationship with local native plants all her life. For the past 12 years she has worked in environmental education and nonprofit leadership. When not working, she can be found gardening, hiking, or creating pottery on a little farm outside of Fayetteville with her husband, two sons, and a variety of domestic and wild species. As Vice President, Roslyn will be in training to step into the role of President in 2024.

Shonda Garrison - Secretary

Shonda lives in Huntsville with her husband and four children and is an office administrator of 13 years. Shonda and her husband own and operate Moonlit Heights Native Nursery, where they grow ONLY Arkansas native plants. In her spare time, she enjoys herbalism, hikes through the woods, and photography.

Eric Fuselier – Treasurer

Eric is a National Director for Wild Ones and served as the President of the Ozark Chapter from 2020-2022. Eric works as a Project Scientist at Olsson where he develops vegetation and soil management plans for native pollinator plantings under solar arrays and utility right-of-ways, and works with engineers and planners to minimize the environmental impact from infrastructure projects. Eric is currently working with the City of Fayetteville to develop a Climate Action Plan based on ecological resilience.

Scott Biehle – Membership Chair

Scott is a teaching assistant professor in the Department of Landscape Architecture in the Fay Jones School of Architecture and Design. His teaching load includes courses in landscape construction, plants, and planting design. He continues to practice in the Northwest Arkansas area. Prior to moving to Arkansas, Scott practiced with Ten Eyck landscape architects and was a solo practitioner in Austin, Texas.

INTRODUCING Wild Ones NATIVE PLANTS, NATURAL LANDSCAPES OZARK CHAPTER 2023 BOARD MEMBERS

Cody George

Cody is the Ecological Horticulturist for Native Restoration and Management, an affiliate of Ecological Design Group, where he creates and promotes bio-diverse landscapes through ecological and organic land care. Cody is a University of Arkansas graduate with a degree in Landscape Horticulture and is an Accredited Organic Land Care Professional. He has over 17 years of experience in the green industry of Arkansas with 11 years in public garden management in Northwest Arkansas. His career in the Arkansas green industry began in 2004 at a local nursery as a nurseryman, landscape crew supervisor, and tree planting supervisor.

Danny Barron

Danny is a native of northwest Arkansas, though he has lived throughout the plains states. He has gardened in Arkansas, Nebraska, Oklahoma, and Texas. Danny's favoring of native plants began in 2000, when he decided to attempt the recreation of a prairie on his property in northeast Oklahoma which had been cleared from savanna only ten years before. Due to family issues, he had to leave that property and move back to an urban environment in Arkansas. Perhaps this is his chance to try a small-scale naturalistic setting not based on controlled burning?

Laurie Scott

Laurie is the Lab Coordinator and Land Manager in the Science Department at Northwest Arkansas Community College (NWACC) where she maintains the native plant beds and greenhouse and coordinates seed collection, cleaning, stratification, and germination of native plants propagated on the NWACC campus. She maintains the Outdoor Living Laboratory which contains a marsh, a pond, and a Post Oak Savanna remnant that is currently being restored. Laurie is also on the steering committee for the Arkansas Monarch and Pollinator Partnership (AMCP) and co-chairs the Monitoring and Research committee and is an active member of AMCP's Education and Outreach committee. Laurie is also an Arkansas Master Naturalist as well as a member of Quail Forever.

Meagan Love

Meagan is an Arkansas native who's always lived in Northwest Arkansas. She enjoys gardening, entomology, and being with her family. Most of her time is spent working with native plants. She is the site manager at Compton Gardens and Arboretum. Her goal is to connect the community through nature, education, and preservation. Her background and college degree are in Horticulture. The last 25 years she has worked in many aspects of the horticulture industry. By far her favorite job is working at Compton Gardens. She loves the idea of introducing and educating the public about the natural world that directly surrounds us.

Blue Lobelia, *L. siphilitica*
Photo: Pam Morgan

Patty Severino

Patty is a native of Northwest Arkansas, although like many in the seventies she left for the greener pastures of the San Francisco Bay area where she spent 30 years before returning. She was farm raised and is now a farmer who is slowly changing to regenerative practices. She studied environmental science at the University of Arkansas, with an emphasis on soils. She has been a member of Northwest Arkansas Master Naturalists, with one year of board experience and has worked in the NWAMN greenhouse. Patty has been a member of the local chapter of Wild Ones since its inception and has been one of the members who advises people trying to transition to native gardens.

Rachel Chapko

Rachel Chapko is on a mission to expand community garden spaces and to make organic gardening a practice for any American. To promote biodiversity and honor Native American cultures, Rachel strives to implement as many native plants as possible into gardens across America to be used "by the people, for the people".

INTRODUCING Wild Ones NATIVE PLANTS, NATURAL LANDSCAPES OZARK CHAPTER 2023 JOURNAL VOLUNTEERS

Bethany Douglas, Ozark Wild Ones Editor
Bethany has lived in Northwest Arkansas for 6 years. She loves hiking, swimming, biking, kayaking, and all things outdoors. Having received a bachelor's degree in English, Bethany decided to shift gears after moving to Arkansas and beginning work in agriculture. She has learned a lot about farming and gardening as well as native plants working at several non-profits and Crystal Bridges Museum of American Art. She currently works for the City of Fayetteville on the Square Gardens horticulture team planting native beds throughout Fayetteville.

Journal questions and submissions:
editor.wildonesozarkchapter@gmail.com

Shawn Hunter, Ozark Wild Ones Designer
A U.S. Navy veteran who received a BA in Graphic Design from John Brown University, Ms. Hunter has lived in Gentry, Arkansas since 1970. She founded and operated Inuendos Design Company in Siloam Springs, retiring in 2020. Having served as a Gentry Chamber of Commerce Member, Gentry Public Library President, Siloam Springs Center for the Arts Founding President, Leadership Benton County 2013 Graduate, she is currently a member of NWA Master Naturalists and Ozark Wild Ones. She enjoys traveling State and National Parks, #urbansketching and photography @barefootnwa. Her compassion for all living things compels her to protect and learn about the things that can not speak for themselves.

2023 Program Schedule

Saturday, January 7 **11:30am-1pm**
"Native Plant Landscaping for Beginners"
with Eric Fuselier

Saturday, February 11 **11:30am-1pm**
"How to Attract & Support Winter Wildlife
in the Off-Season" with Dr. Susan Rupp

Saturday, March 11 **11:30am-1pm**
FIELD TRIP: Eureka Springs Community Center
Greenhouse

Saturday, April 8 **11:30am-1pm**
FIELD TRIP: Spring Ephemeral Hike at Lake Wilson
in Fayetteville

Saturday, May 13 **11:30am-1pm**
FIELD TRIP: Compton Gardens & Arboretum
in Bentonville

And more in the works for June to December, including some exciting field trips, seed swaps, and gatherings!

Why the World Needs Us to Stop Growing Grass Lawns

By Allison Sloan

#1

The grass lawn is an unnatural landscape invention from Europe. The first lawns were created in 17th and 18th Century England and France as status symbols by wealthy landowners displaying that they had land to waste on non-agricultural use, and sheep or scythe-wielding servants to keep the grass shorn. Grass lawns were first exemplified in America on the estates of George Washington and Thomas Jefferson, who, though eager to dispel British colonial rule, still eagerly embraced English landscaping ideas. While grass seeds were originally brought to the U.S. in the 1600s as forage for livestock, grass lawns remained uncommon in America until upper class estates began planting them in the late 1800s, encouraged by gardening books and magazines and facilitated by the invention of the lawnmower. It wasn't until the 1940s and 50s that lawns became widely accessible to the masses, thanks to mass production of gas-powered lawn mowers, and to newly sprouting suburban developments such as Levitttowns[1] that mandated uniformly cut grass lawns connecting tracts of houses. Today Americans grow more turf grass than corn or any other food crop, and our carpet of green grows by about 600 square miles every year from new development.

7 REASONS

#2

Grass lawns stamp out the native biodiversity that is our natural heritage. Ever wonder why lawns are so difficult to keep weed-free? Because they represent Americans' attempt to displace our natural landscapes with imported grasses that require ample water, fertilizers and herbicides to dominate and flourish in our varying soil types and climates. Turf grass species are not native to North America – even Kentucky bluegrass was brought over from Europe – and since most insects and wildlife do not recognize non-native plants as food sources, closely mowed grass lawns are of little use to most species. NASA imagery shows that turf grass has been planted over at least 63,000 square miles of U.S. land, eradicating these 63,000 miles of wildflowers, grasses, trees and shrubs that had evolved over eons to thrive in each local climate, and in turn threatening the insects, birds, and other wildlife that relied on those plants for food and habitat. As stated by David Mizejewski, a naturalist with the National Wildlife Federation, "Lawns are a significant environmental problem... We put in these lawns, and we basically turned these important habitats into dead zones." Loss of habitat and food has led to declines in plant, animal and insect populations and diversity. Insect populations are collapsing worldwide, raising alarm about future food shortages, and diminishing populations of songbirds, who need ample supplies of caterpillars to rear chicks. (A recent study found that chickadees choose to nest only in yards with at least 70% native plants to ensure a caterpillar supply).

[1] Levittown was the name given to suburban housing developments in New York and Pennsylvania created by the company Levitt & Sons between 1947 and 1963. Using an "assembly line" method, the company was able to construct a house in as little as one day.

#3

Grass is thirsty, wasting water that could be used to sustain us and grow our food. How much water does grass use? By EPA estimates, about 9 billion gallons per day nationwide – that's billion with a "b." On average, that's one third of all municipal water supplies flushed out through our sprinklers. Even in water-rich areas such as ours, watering lawns squanders the energy and electricity required to filter and supply fresh tap water to pipelines. It's quite a feat when you "think of the miracle that is the modern water supply," writes Christopher Ingraham in The Washington Post, "pristine water pumped hundreds of miles, passed through shiny state-of-the-art filtration systems, treated with miracle chemicals that keep our teeth from falling out of our heads, and available on-demand at the twist of a knob. And then consider that we intentionally dump billions of gallons of that water out on the ground!" Alternative: Native plants require little to no water once established.

#4

Lawn pesticides pose a health risk. Pesticides are designed to kill living things and are by nature toxic: their Latin root "-cide" means "to kill." Growing a monocrop of only one grass species is not possible without killing competing plants and insects, and nowhere is this more apparent than our lawns, where Americans combined spray over 70 million pounds of chemical pesticides each year – more per acre than are used on farms. Regulatory agencies are not always protective: over 18,000 non-Hodgkin's lymphoma patients have filed suit against Monsanto, claiming that its Roundup weedkiller caused their cancer. In the three trials to conclude so far, the juries returned guilty verdicts and slapped huge financial penalties on the pesticide maker. Children and pets are most vulnerable to pesticides because they breathe and play closer to the ground. The American Academy of Pediatrics has expressed concern that "Epidemiologic evidence demonstrates associations between early life exposure to pesticides and pediatric cancers, decreased cognitive function and behavioral problems."

Swallowtail caterpillar on Native Zizzia Aurea

Alternatives: Native wildflower/pollinator gardens, prairie gardens, woodland gardens, rain gardens, wildflower borders.

#5

Lawn fertilizers fill rivers and lakes with algae. Those 90 million pounds of chemical fertilizers that we spread on lawns each year don't stay put. They wash away into lakes and rivers, fertilizing the cyanobacteria that create algal blooms, oxygen-depleted "dead zones" which kill fish and aquatic life. Algal blooms are rising sharply. New research from the Environmental Working Group shows at least 550 reported blooms across 48 states since 2010. Blooms are becoming more toxic, too, even shutting down the Toledo, Ohio, drinking water supply in 2014. (For a map, see ewg.org/toxicalgae) Alternative: Leave grass clippings on lawns as a natural fertilizer.

#6

Lawn mowers contribute to air pollution and climate change. Gas powered lawn equipment belches out about 5% of the nation's air pollution. Our forty million lawnmowers consume 200 million gallons of gasoline per year and emit greenhouse gasses into the atmosphere. Alternatives: Human powered push mowers; electric mowers; natural landscaping.

#7

Lawns cost us dearly in money, time and energy. Consider that the lawn care industry is a $40 billion per year business, and that the average American spends 70 hours per year maintaining their lawn. Now imagine your lawn with the landscape it might have hosted 200 years ago, as a forested woodland garden or a prairie garden, or with an edible landscape and kitchen herb garden that will nourish humans and wildlife alike. Consider investing at least part of that money and time spent mowing grass towards repopulating at least some of your place on Earth with the wildflowers, grasses, shrubs and trees that originated here. It's time we all take a walk on the wild side and do our part by growing green the natural way.

Grass-free landscape ideas:
https://home.howstuffworks.com/10-green-lawns-without-a-blade-of-grass.htm

For help identifying and locating native landscape plants:
National Wildlife Federation's Native Plant Finder www.nwf.org/nativeplantfinder/

To schedule a site visit with Wild Ones Ozark Chapter:
https://ozark.wildones.org/visits/

Allison Sloan is a graduate of Fayetteville High School (class of 1988). She currently resides and gardens in Evanston, Illinois, where she is owner of the Shady Grove Wildflower Farm and steward of the Harbert-Payne Woods native plant restoration.

Alternatives: "Freedom lawns" are still mowed but accept whichever plants sprout up to fill in the spots too shady, moist, dry, sandy or acidic for grass to thrive; nontoxic integrated pest management (IPM) techniques are at Midwest Grows Green, https://midwestgrowsgreen.org.

Don't miss a thing !

Keep in Touch!

Sign up for the newsletter to receive updates
and reminders & follow us on your favorite social media!

wildonesozarkchapter@gmail.com

https://www.youtube.com/c/wildonesozarkchapter

https://www.tiktok.com/@ozarkwildones

https://www.instagram.com/ozarkwildones/

https://www.facebook.com/OzarkWildOnes/

Site Visits

As people transition to using more native plants in their landscapes, they often need support and advice. The Ozark Chapter of Wild Ones is now offering the service of onsite visits in Northwest Arkansas.

The role of the Site Visits Committee is to offer guidance, encouragement, resources, and professional connections to homes and non-profits.

Our services will be offered in a manner that does not compete with professionals.

If you would like to sign up for a visit, fill out the short form at **https://ozark.wildones.org/visits**.

Native Plant Sources

Visit our website for an up to date listing of Ozark specific native plants:

https://ozark.wildones.org/plant_sources_allied_orgs/

Members Only Access

Members of Wild Ones have exclusive access to abundant resources on the national Wild Ones website. Registration gives you access to files, publications, and articles only available to members. On the upper right-hand corner of the main page is a "member login" button that will give you instructions for registering. You'll be able to access archived Journal articles, vote on the annual photo contest, sign up for the discussion group, and much more!

https://ozark.wildones.org/

FREE
OZARK CHAPTER T-SHIRTS FOR MEMBERS WHO VOLUNTEER!

A wide variety of sizes are available!

Volunteer opportunities include:

- Service on the board of directors or on one of our committees
- Lake Springdale Trailhead Raingarden & Bioswale
- Participation in Wild Ones Site Visits
- Invasive species removal at Lake Wilson in Fayetteville
- Planting natives and removing invasives at Callie's Prairie in Fayetteville
- Planting, maintenance,and invasive species removal at Compton Gardens in Bentonville
- Planting, maintenance, and invasive species removal at Osage Park in Bentonville
- Participation in the Eureka Springs Native Plant Collaborative project

Contact WildOnesOzarkChapter@gmail.com to learn how you can get involved!

Easy Propagation of Native Wildflowers

By Larry Price

I have an easy method of germinating my wildflower seeds which I have used for the last two years. I had made a decision I was not going to cold stratify my seeds in my refrigerator. Instead, I would plant them in small containers under some sort of protective structure. For large area plantings the seeds are randomly distributed without regard to the method of breaking seed dormancy. It works, so I thought it could be used for germinating nursery plants. I distributed the seeds over the top of a seed starting media and relied on the frost cycle to stratify them, just as I had done with larger field plantings.The plants needed protection from rodents and birds. I remembered I had saved a couple of old window screens from the replacement of our windows years ago. I found them after looking a while. I placed them over the seeded containers, using old bricks to prop them at the correct level. I had old screen-type gutter guards I had gotten the workers to save after a gutter upgrading. This provided the protection for the sides of the enclosure.

A major benefit of the screens is breaking up large raindrops and the water from a watering can or hose. This prevents the seeds being thrown into the wrong container, buried too deeply or even lost. The first year I used old flower pots. **The method worked well for 15 species.** This last winter I planted more than 30 species, including 6 species of Milkweeds. I decided to use leftover mushroom containers to avoid the single-use problem. Even though they were relatively shallow, they worked very well. I drilled 5 holes in the bottom of each. My medium was a Sphagnum/Perlite combination. I sat the containers directly on the ground. The first plants to germinate this spring were the Jerusalem Artichokes (*Helianthus tuberosus*). The last to germinate are our two native species of Hibiscus. I get great germination from Purple Coneflower (*Echinacea purpurea*), but poor germination from Pale Purple Coneflower (*Echinacea pallida*). Rough Coneflower (*Rudbeckia grandiflora*) is another one with poor germination. The milkweeds (*Aesclepius*) do great with this technique, as do the Blazing Stars, native sunflowers (*Helianthus*), various Coreopsis and the Rosinweed group (*genus Silphium*).

The tiny plants make for some tedious work, easing them out with the point of a plastic plant label. The long tap roots are carefully wrapped into the premade hole in the medium. I placed the newly planted babies in the shade for a couple of days before placing them in full sun on my hardware cloth table. Survival has been excellent.

This is a simple, but effective method that works regardless of a plant's way of breaking dormancy. If you have an old screen, or two, try it out. It works great if you want to recycle mushroom containers.

Larry S. Price - Retired medical doctor, 13 year Arkansas Master Naturalists, Former president of the board AMN, Former team lead, Project Wingspan, 30+ year member Arkansas Native Plant Society, Co-leader Russellville Citizens Climate Lobby, 30+ year contributor to The Nature Conservancy, Participant with the Arkansas Game and Fish Commission in Acres for Wildlife

INTERESTED IN CREATING OR IMPROVING POLLINATOR HABITAT ON YOUR FARM OR RANCH?

POLLINATOR PARTNERSHIP CAN HELP!

Looking for technical or financial assistance to help you reach your land stewardship goals?

Our liaisons can share resources and assist you in connecting with your local field office.

There are many programs available to help you apply conservation practices that can improve soil health, biodiversity, and production on your lands. Let us help you get started!

VISIT WWW.POLLINATOR.ORG/NRCS-LIAISONS

POLLINATOR PARTNERSHIP

Pollinator Partnership Arkansas

Sara Wittenberg
NRCS Pollinator Liaison

Have Questions?
Contact Sara at
sw@pollinator.org

The Way it Once Was

By Danny Barron

In the early 1970s, I remember one early June evening riding with my parents to my grandparents' home. It was surrounded by pastureland which usually didn't run cattle, aka grasslands. There were so many insect swarms of small gnat-like insects that the windshield washers had to be used nearly constantly. An afternoon shower had just concluded and everything was wet and steamy. You could see the clouds of insects swirling in the heavy moist air. Along the dirt road, there were American toads by the hundreds. They were on the road, in the ditch, and all through the grasses. You could see them sometimes jumping just above the short grass along the mowed stretch to snatch a bug. I don't remember if you could hear them, but probably not as it was probably past mating and spawning season.

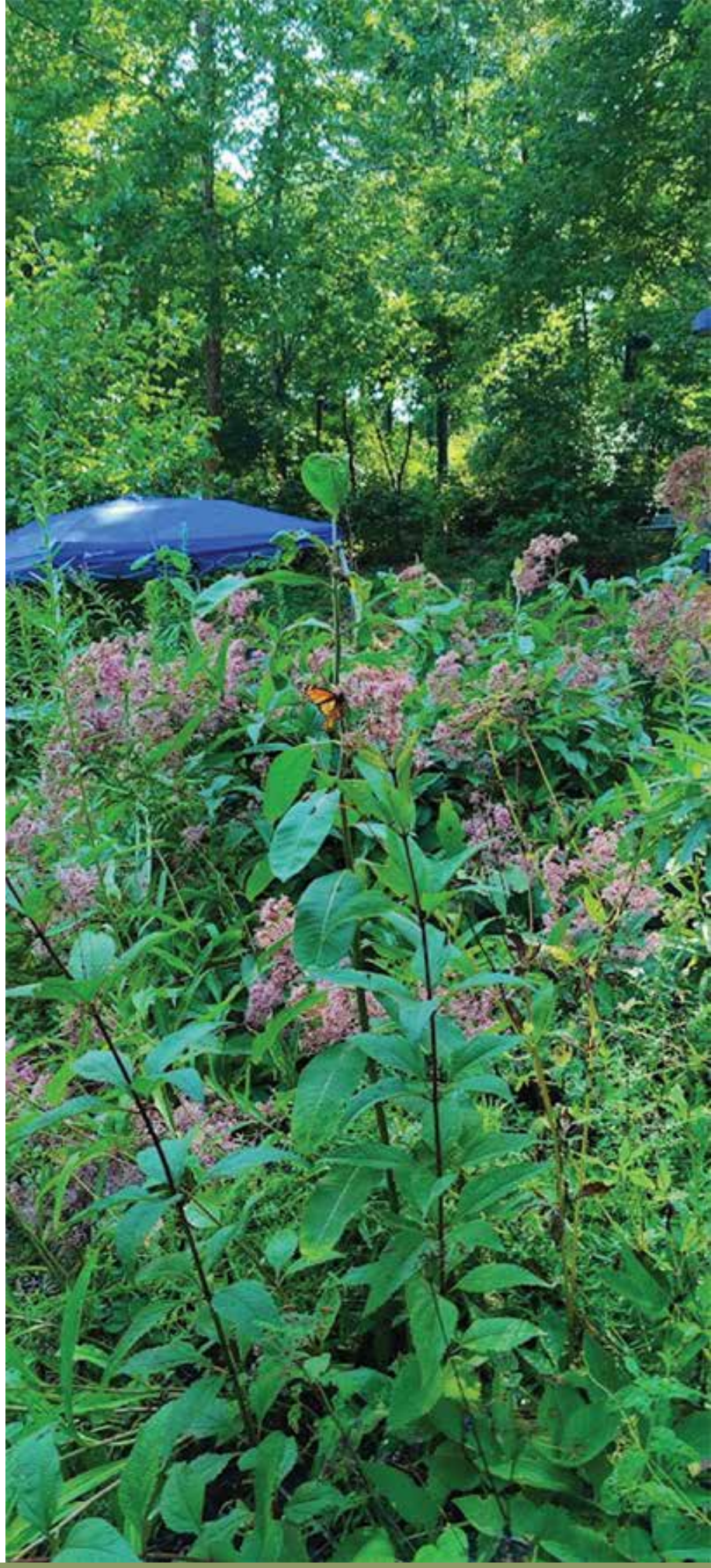
Small birds were skimming over the grass, catching the insects that were in such abundance. While I don't remember their calls either, I'm sure there were some, because birds aren't usually silent for long. I remember meadowlarks, red-winged blackbirds, various native sparrows (that was before the English sparrow was the predominant sparrow), mockingbirds, flycatchers, bluebirds, and the like. Several species of snakes were typically found coiled in the sun. Garter snakes, black snakes, several clades of rat snakes, hog-nosed snakes. These are what I remember, though I'm sure there were others. Once in a while, you'd glimpse a skunk out for rodents and possibly toads as dusk descended and a new range of clouds of squishy night-flying insects took flight. Bats circled yard lights voraciously. If you had a flashlight, you'd be the epicenter of a swirling tornado of moths, mosquitoes, and various other unidentified nightlife.

Fast forward fifty years...

Today the road is graveled, the pastures remain mostly the same, though the small copses of wild plums that were spotted across the grasses back when I was a child are now gone. The fence-rows are now clean, due to herbicide application. Native plants that had remained in the fence-rows and occasionally dotting the pastures are long gone. All in all, it looks much less inviting to a naturalist, and to nature. There are no clouds of insects either night or day. A single toad might be encountered once or twice a year. An occasional tree-frog is spotted around the house. There remains a small colony of garter snakes that roam my yard (not my grandparents, it's not in the family anymore), but the occasional shed skin found in the garage argues that I probably have at least one black snake around. The bird population has crashed and only seed and fruit eating birds remain in lesser numbers (robins, blue jays, cardinals, and mockingbirds) with the occasional wren that the free-ranging cats haven't murdered. The insect eating birds are largely gone. I have seldom, if at all, seen any bats in the last fifteen years.

The air is clear of insects and mostly silent.

Danny was born in a hospital in Fayetteville, Arkansas. Despite living across the plains states, he has maintained strong ties to Arkansas, both blood ties and affinity to the living organisms of the Natural State. He learned to love gardening with ornamental (and often unbeknownst to him, native) plants from his maternal great grandmothers and his maternal grandmother. Unfortunately, his grandmother's taint of raising food crop plants skipped a generation, though she also had quite a number of flowering plants to nurture the soul as well as the edibles for the stomach. On his father's side of the family, came the blood of the Keetoowah Cherokee and a reverence for nature.



For More Than Just Pollinators, Part III

Native Plants for Remediating Heavy Metal Contaminated Soil

By Eric Fuselier

Eastern gamagrass (Tripsacum dactyloides) Photo: Eric Fuselier

Without soil, life on land would be impossible. Soil is a medium for plant growth and a habitat for living organisms. Our society depends on soil to grow our food, and to support the web of life upon which we all depend. History has shown that civilizations that do not take care of the soil eventually suffer the consequences of their poor choices and collapse. Even today, we could easily suffer the same fate if we are not wise in our approach toward soil management.

One such way that soils can become degraded is through the accumulation of toxic levels of heavy metals. Soil can become contaminated with heavy metals through a variety of means, from main tailings, smelting operations, leaded gasolines and paints, wastewater irrigation, and by land application of fertilizers, pesticides, animal manures, and sewage sludge.

Soil is a major sink for heavy metals and can pose risks and hazards to both humans and the ecosystem through such means as physical contact or direct ingestion of contaminated soil, through the drinking of contaminated groundwater, or through the food chain (soil-plant-human and soil-plant-animal-human). Exposure to toxic levels of heavy metals can have adverse effects on human health, such as decreasing our immunological defenses, impairing our mental faculties, and increasing our risk of upper gastrointestinal cancer.

In Arkansas, accidental releases of industrial waste have in the past contaminated the soil at certain locations with heavy metals. Some of these sites are still listed by the Environmental Protection Agency as Superfund sites today. Phytoremediation using native plants offers one potential solution for remediating soil contaminated with heavy metals. While trying to avoid giving the implication that phytoremediation is the perfect solution in every case of heavy metal contamination (or for any specific Superfund site in Arkansas), this article will simply examine how phytoremediation of heavy metals works, leaving it to the engineers and environmental professionals to determine when this technique would be a feasible alternative for remediating heavy metal contaminated soil on a particular project which they may find themselves working on.

How it Works

Unlike organic contaminants, heavy metals cannot be broken down to make them less toxic. Because of this, other methods than we have previously discussed will need to be used to remove these elements from contaminated soil.

The first step is to identify native species that can colonize metalliferous soils. (Partial list of native plants begins on page 20) Heavy metals generally produce toxic effects on most plant species making it difficult or impossible for them to survive in these soils. Adverse effects that heavy metals have on plants include low biomass accumulation, chlorosis of leaf tissue, inhibition of photosynthesis, altered water balance, or altered nutrient assimilation, all of which can ultimately cause the plant to die. However, some plant species have evolved physiological mechanisms that enable them to tolerate metal toxicity, and allow them to grow in soil contamiated with heavy metals.

"Accumulator" species are those plant species that can absorb metals from the soil into their tissues. In order to do this, the metal must first be dissolved into a solution that the plant roots can absorb. Once this has happened, the plant roots can then absorb the solution, along with the heavy metal. Once absorbed, the plant must then surround the heavy metal and bond it chemically to an organic compound (a process known as chelation) to both protect itself and make the metal more mobile. Once the metal has been chelated, the plant can then transport the metal to a location where it can be stored safely. The transportation stage is the most critical, since the heavy metal is most likely to damage the plant during this process, and the plant must adapt to any damage the heavy metal causes. Once the heavy metal has been transported, it is then stored in a location where it cannot damage the plant, typically within the vacuoles of the plant cells.

"Hyperaccumulator" species are similar to accumulator species, but can absorb extremely high levels of heavy metals into their tissues due to having overdeveloped metal transport systems. In hyperaccumulators, heavy metals are most often stored in the vacuoles of the cells within the leaves of the plant.

With these adaptations in mind, there are two main phytotechnological mechanisms that we can make use of when trying to improve the quality of soil contaminated with heavy metals:

Phytoextraction refers to the absorption and uptake by plants of large amounts of inorganic contaminants such as heavy metals, and to the translocation of these contaminants into the aboveground parts of these plants. With this technique, consider using hyperaccumulator species, or accumulator species with a high growth rate and that produce a high quantity of biomass. In order for these species to effectively remediate soils contaminated with heavy metals, the plants must be harvested after an adequate period of growth that allows them to accumulate the metal contaminants in sufficient quantities, and then removed and disposed of in a manner that is in accordance with local, state, and/or federal environmental laws and regulations. For herbaceous species this means harvesting the plant at the most optimal time during the growing season to maximize the uptake of soil contaminants before the above-ground portion of these species begin to decompose and return the elements to the soil.

Phytometabolism refers to the uptake of heavy metals by plants followed by the incorporation of these heavy metals into their tissue as nutrients. At low levels, some heavy metals such as copper, nickel, and zinc are nutrients that are essential for plants to carry out their physiological processes. Depending on the heavy metal(s) contaminating a soil, phytometabolism may be an effective technique for soil remediation.


Eastern gamagrass
Tripsacum dactyloides
Photo: Eric Fuselier

However, not all metals are equal in their ability to be extracted from soil. Some metals such as nickel can be extracted quite easily, while phytoextraction of other heavy metals such as cadmium can take decades or even centuries. For heavy metals that are difficult or impossible to extract, other techniques must be considered.

Phytostabilization of heavy metals is the use of certain plant species to immobilize contaminants found in soil by sequestering them in the woody biomass of the plant. It should be noted that this technique does not remove the heavy metals from the site, but effectively immobilizes or stabilizes them, with the goal being the long-term stabilization and containment of the pollutant to prevent it from entering the trophic chain.

Cadmium (Cd)

Sources of cadmium contamination in soil can include fertilizers, sewage sludge, NiCd Batteries, mining activities, and smelting operations. Phytoextraction can be effective for low levels of cadmium contamination. If cadmium concentrations are too high, plant growth is inhibited, making phytoextraction difficult. As mentioned above, phytoextraction of cadmium is a very slow process that can take decades or centuries.

However, due to the high bioavailability of cadmium, phytoextraction can still be employed when it presents a danger to food chains, such contamination occurring in ecological sensitive areas.

Phytostabilization of cadmium can be employed by using large woody accumulator species often used for biomass production, such as willows (*Salix* spp.), poplars (*Populus* spp.), that will effectively sequester the cadmium in their biomass.

Zinc (Zn)
Sources of zinc contamination in soil can include mining activities, smelting operations, steel production and galvanization, and tire dust & debris. Like cadmium, phytoextraction can be effective for low levels of zinc contamination that don't inhibit the growth of the plants being used, but is a very slow process that can take decades or centuries. But due to zinc's high bioavailability, phytoextraction can still be employed when it presents a danger to food chains.

However, zinc is also a plant micronutrient, and phytometabolism can be feasible in situations where the concentration of zinc in the soil doesn't inhibit the plant's growth. And because it is a micronutrient, large woody accumulator species used for biomass production can be used to sequester zinc as a form of phytostabilization.

Phytostabilization of zinc can also be accomplished using willows (*Salix* spp.) to sequester zinc in the woody biomass.

Copper (Cu)
Sources of copper contamination in soil can include pesticide residues, mining activities, and smelting operations. Phytoextraction of copper is moderately difficult and not a feasible option for field scale remediation projects. Like zinc, copper is a plant micronutrient, and phytometabolism can be feasible in situations where the concentration of copper in the soil is not so high that it inhibits the ability of the plants to grow.

Chromium (Cr)
Sources of chromium in soil can include pressure-treated lumber, paints, leather tanning, and the automotive industry. However, phytoextraction of chromium is very difficult and not a feasible option for soil contamination.

Nickel (Ni)
Sources of nickel in the soil include battery production, stainless steel production, mining activities, and burning of fossil fuels and wind-blown dusts from industrial areas. Phytoextraction is an effective means of removing nickel and an efficient technique for field scale remediation projects. Because nickel has high bioavailability, phytoextraction should be considered when it presents a danger to nearby food chains.

Phytomining
Phytomining is a technique that uses high-biomass plants that accumulate metals to be reclaimed for reuse. Once the accumulator species have had sufficient time to extract heavy metals from the soil, the plants are then harvested and burned into ash. This ash is then smelted to produce a metal. This exciting new field of research offers a potential alternative to existing, environmentally destructive, opencast mining practices, and holds potential for the extraction of ore bodies that are currently uneconomical to mine by conventional methods. With existing technology, research indicates that phytomining nickel shows the most promise for being an economical technique for reclaiming this metal because of the ease with which nickel can be extracted from soil. Perhaps with more research, other metals will become more economical to phytomine as well.

Conclusion
Improving soil quality, especially with regard to heavy metal contamination, is yet another application of phytoremediation in which native plants can help improve environment quality. By employing extraction plots, many types of heavy metals can be removed from the soil to reduce ecological harm and prevent adverse health effects to humans and wildlife. Furthermore, the emerging science of phytomining provides hope that perhaps we'll soon see a day when remediating soil contaminated with heavy metals has become an economically viable industry. Perhaps soon we'll see a day where certain Superfund sites are seen as a lucrative opportunity to improve the environment.

References*

NATIVE SPECIES FOR PHYTOREMEDIATION OF CADMIUM (Cd)					
Common Name	Scientific Name	Vegetation Type	Sunlight requirements	Soil moisture requirements	Accumulation Type
Common Yarrow	*Achillea millefolium*	Forb	Full sun	Dry to medium	Accumulator
Fox Sedge	*Carex vulpinoidea*	Sedge	Full sun to part shade	Wet	Accumulator
Canadian Horseweed	*Conyza canadensis*	Forb	Full sun	Dry to medium	Accumulator
Dogfennel	*Eupatorium capillifolium*	Forb	Full sun to part shade	Medium	Accumulator
Common Sunflower	*Helianthus annuus*	Forb	Full sun	Dry to medium	Accumulator
Jerusalem Artichoke	*Helianthus tuberosus*	Forb	Full sun to part shade	Dry to medium	Accumulator
Deciduous Holly	*Ilex decidua*	Tree	Full sun to part shade	Medium	Accumulator
American Holly	*Ilex opaca*	Tree	Full sun to part shade	Medium	Accumulator
Switchgrass	*Panicum virgatum*	Grass	Full sun to part shade	Medium to wet	Hyperaccumulator
Coastal Plain Willow	*Salix caroliniana*	Tree	Full sun to part shade	Medium to wet	Accumulator
Heart-leaved Willow	*Salix eriocephala*	Tree	Full sun to part shade	Medium to wet	Accumulator
Sand Willow	*Salix interior*	Tree	Full sun to part shade	Medium to wet	Accumulator
Prairie Willow	*Salix humilis*	Tree	Full sun to part shade	Medium	Accumulator
Black Willow	*Salix nigra*	Tree	Full sun to part shade	Medium to wet	Accumulator
Prairie Cordgrass	*Spartina pectinata*	Grass	Full sun to part shade	Medium to wet	N/A

NATIVE SPECIES FOR PHYTOREMEDIATION OF CADMIUM (Cd) cont'd					
Johnny Jump Up	*Viola bicolor*	Forb	Full sun to part shade	Dry to medium	Accumulator
Bog White Violet	*Viola lanceolata*	Forb	Full sun	Wet	Accumulator
Missouri Violet	*Viola missouriensis*	Forb	Full shade to part shade	Medium	Accumulator
Northern Bog Violet	*Viola nephrophylla*	Forb	Part shade to full shade	Wet	Accumulator
Three Lobed Violet	*Viola palmata*	Forb	Part shade to full shade	Medium	Accumulator
Bird's Foot Violet	*Viola pedata*	Forb	Full sun	Dry to medium	Accumulator
Smooth Yellow Violet	*Viola pubescens*	Forb	Part shade to full shade	Dry	Accumulator
Arrow-leaved Violet	*Viola sagittata*	Forb	Full sun to part shade	Dry to medium	Accumulator
Common Blue Violet	*Viola sororia*	Forb	Full sun to part shade	Medium	Accumulator
Striped Cream Violet	*Viola striata*	Forb	Part shade	Medium to wet	Accumulator
Palmate-leaved Violet	*Viola subsinuata*	Forb	Part shade	Dry to medium	Accumulator
Carolina Violet	*Viola villosa*	Forb	Part shade	Dry	Accumulator

Adesodun, J. K., Atayese, M. O., Agbaje, T., Osadiaye, B. A., Mafe, O., and Soretire, A. A. (2010). Phytoremediation potentials of sunflowers (*Tithonia diversifolia and Helianthus annuus*) for metals in soils contaminated with zinc and lead nitrates. *Water, Air, and Soil Pollution* 207 (1-4), pp 195-201.

Algreen, M., Trapp, S., and Rein, A. (2013). Phytoscreening and phytoextraction of heavy metals at Danish polluted sites using willow and poplar trees. *Environmental Science and Pollution Research*, epub. Ahead of print, DOI, 10.1007/s11356-013-2085-z.

Baker, A. J. M., and Brooks, R. R., (1989). Terrestrial higher plants which hyperaccumulate metal elements - a review of their distribution, ecology, and phytochemistry. *Biorecovery* 1, pp. 81-126.

Baker, A. J. M. (2000). Metal-accumulating plants. In I. Raskin and B. Ensley (Eds.) *Phytoremediation of Toxic Metals*. New York: John Wiley and Sons, Inc., pp 193-229.

Blaylock, M. J., and Huang, J. W. (2000). Phytoextraction of metals. In I. Raskin and B. D. Ensley (Eds.) *Phytoremediation of Toxic Metals: Using Plants to Clean Up the Environment*, New York: John Wiley and Sons, Inc., pp. 53-70.

Brooks, R.R. et al. (1977). Detection of nickeliferous rocks by analysis of herbarium specimens of indicator plants, *Journal of Geochemical Exploration* 7, pp. 49–57.

Brooks, R.R., ed. (1998). Plants that *Hyperaccumulate Heavy Metals*, CAB International.

NATIVE SPECIES FOR PHYTOREMEDIATION OF ZINC (Zn)					
Common Name	Scientific Name	Vegetation Type	Sunlight requirements	Soil moisture requirements	Accumulation Type
Sideoats Grama	*Bouteloua curtipendula*	Grass	Full sun	Dry to medium	Accumulator
Canadian Horseweed	*Conyza canadensis*	Forb	Full sun	Dry to medium	Accumulator
Common Sunflower	*Helianthus annuus*	Forb	Full sun	Dry to medium	Accumulator
Coastal Plain Willow	*Salix caroliniana*	Tree	Full sun to part shade	Medium to wet	Accumulator
Heart-leaved Willow	*Salix eriocephala*	Tree	Full sun to part shade	Medium to wet	Accumulator
Sand Willow	*Salix interior*	Tree	Full sun to part shade	Medium to wet	Accumulator
Prairie Willow	*Salix humilis*	Tree	Full sun to part shade	Medium	Accumulator
Black Willow	*Salix nigra*	Tree	Full sun to part shade	Medium to wet	Accumulator
Eastern Gamagrass	*Tripsacum dactyloides*	Grass	Full sun to part shade	Medium	Accumulator

Chaney, R.L. (1983). Plant uptake of inorganic waste constituents, in *Land Treatment of Hazardous Wastes* (Parr, J.F. et al., eds), pp. 50–76, Noyes Data Corp.

Chaney, R.L. et al. (1998). Method for phytomining of nickel, cobalt and other metals from soil, *US Patent 5711784*

Cutright, T., Gunda, N., and Kurt, F. (2010). Simultaneous hyperaccumulation of multiple heavy metals by Helianthus annuus grown in a contaminated sandy-loam soil. *International Journal of Phytoremediation* 12, pp. 562-573.

Dickinson, N. M., Baker, A. J., Doronila, A., Laidlaw, S., and Reeves, R. (2009). Phytoremediation of inorganics: realism and synergies. *International Journal of Phytoremediation* 11, pp. 97-114.

Evangelou, M. W., Robinson, B. H., Gunthardt-Goerg, M.S., and Schulin, R., (2013). Metal uptake and allocation in trees grown on contaminated land: implications for biomass production. *International Journal of Phytoremediation*. 15 (1), pp. 77-90.

Gawronski, S., Greger, M., and Gawronska, H. (2011). Plant taxonomy and metal phytoremediation. In I. Sherameti and A. Varma (Eds.) *Detoxification of Heavy Metals, Soil Biology* 30, DOI, 10.1007/978-3-642-21408-0_5, Berlin, Heidelberg: Springer-Veriag.

Hinchman, R. R., Negri, M. C., and Gatliff, E. G. (1997). Phytoremediation: Using Green Plants to Clean Up Contaminated Soil, Groundwater, and Wastewater. Submitted to the US Department of Energy, Assistant Secretary for Energy Efficient and Renewable Energy under Contract W-31-109-Eng-38.

Iyaka, Yahaya. (2011). Nickel in soils: A review of its distribution and impacts. *Scientific Research and Essays*. 6.

Kennen, K. & Kirkwood, N., (2015). *Phyto: Principles and Resources for Site Remediation and Landscape Design*. Hoboken: Taylor and Francis.

Kumar, P. B. A. N., Dushenkov, V., Motto, H., and Raskin, I. (1995). Phytoextraction: the use of plants to remove heavy metals from soils. *Environmental Science and Technology* 29, pp. 1232-1238.

Kumari, Poonam & Kumar, & Kumar, Tapan. (2019). An Overview of Phytomining: A Metal Extraction Process From Plant Species. *Journal of Emerging Technologies and Innovative Research* 6 (1). pp. 1367-1376.

Martin, H. W., Young, T. R., Kaplan, D. I., Simon, L., and Adriano, D. C. (1996). Evaluation of three herbaceous index plant species for bioavailability of soil cadmium, chromium, nickel, and vanadium. Plant and Soil 182, pp. 199-207.

NATIVE SPECIES FOR PHYTOMETABOLISM OF COPPER (Cu)					
Common Name	Scientific Name	Vegetation Type	Sunlight requirements	Soil moisture requirements	Accumulation Type
False Indigo Bush	*Amorpha fruticosa*	Shrub	Full sun	Medium to wet	Accumulator
Big Bluestem	*Andropogon gerardii*	Forb	Full sun	Dry to medium	Accumulator
Sideoats Grama	*Bouteloua curtipendula*	Grass	Full sun	Dry to medium	Accumulator
Fox Sedge	*Carex vulpinoidea*	Sedge	Full sun to part shade	Wet	Accumulator
Common Sunflower	*Helianthus annuus*	Forb	Full sun	Dry to medium	Accumulator
Pale Smartweed	*Persicaria lapathifolia*	Forb	Full sun to part shade	Medium	Hyperaccumulator
Coastal Plain Willow	*Salix caroliniana*	Tree	Full sun to part shade	Medium to wet	Accumulator
Heart-leaved Willow	*Salix eriocephala*	Tree	Full sun to part shade	Medium to wet	Accumulator
Sand Willow	*Salix interior*	Tree	Full sun to part shade	Medium to wet	Accumulator
Prairie Willow	*Salix humilis*	Tree	Full sun to part shade	Medium	Accumulator
Black Willow	*Salix nigra*	Tree	Full sun to part shade	Medium to wet	Accumulator
Little Bluestem	*Schizachyrium scoparium*	Grass	Full sun	Dry to medium	Accumulator

McGrath, S.P. et al. (1993). The potential for the use of metal-accumulating plants for the *in situ* decontamination of metal-polluted soils, in *Integrated Soil and Sediment Research: a Basis for Proper Protection* (Eijsackers, H.J.P. and Hamers, T., eds), pp. 673–676, Kluwer

Nicks, L.J. and Chambers, M.F. (1994). Nickel farming, *Discover Magazine*. 19 September.

Nicks, L.J. and Chambers, M.F. (1995). Farming for metals, *Mining Environmental Management* 15–18 September.

Nicks, L.J. and Chambers, M.F. (1998). A pioneering study of the potential of phytomining for nickel, in *Plants that Hyperaccumulate Heavy Metals* (Brooks, R.R., ed.), pp. 313–326, CAB International.

Padmavathiamma, P. K., and Li, L. Y. (2009). Phytoremediation of metal-contaminated soil in temperate humid regions of British Columbia, Canada. *International Journal of Phytoremediation* 6 (2), pp. 119-137.

Reeves, R.D. and Brooks, R.R. (1983). Hyperaccumulation of lead and zinc by two metallophytes from a mining area of Central Europe, *Environmental Pollution. Series A: Ecological and Biological* 31 (4), pp. 277–287.

Reeves, R.D. et al. (1995). Abnormal accumulation of trace metals by plants, *Mining Environmental Management* 4–8 September.

NATIVE SPECIES FOR PHYTOREMEDIATION OF NICKEL (Ni)					
Common Name	Scientific Name	Vegetation Type	Sunlight requirements	Soil moisture requirements	Accumulation Type
Canadian Horseweed	*Conyza canadensis*	Forb	Full sun	Dry to medium	Accumulator
Dogfennel	*Eupatorium capilifolium*	Forb	Full sun to part shade	Medium	Accumulator
Common Sunflower	*Helianthus annuus*	Forb	Full sun	Dry to medium	Accumulator
Black Locust	*Robinia pseudoacacia*	Tree	Full sun	Dry to medium	Hyperaccumulator
Coastal Plain Willow	*Salix caroliniana*	Tree	Full sun to part shade	Medium to wet	Accumulator
Heart-leaved Willow	*Salix eriocephala*	Tree	Full sun to part shade	Medium to wet	Accumulator
Sand Willow	*Salix interior*	Tree	Full sun to part shade	Medium to wet	Accumulator
Prairie Willow	*Salix humilis*	Tree	Full sun to part shade	Medium	Accumulator
Black Willow	*Salix nigra*	Tree	Full sun to part shade	Medium to wet	Accumulator
Balsam Groundsel	*Packera pauperculus*	Forb	Full sun to part shade	Medium	Hyperaccumulator
Hairy Goldenrod	*Solidago hispida*	Forb	Full sun	Dry to medium	Hyperaccumulator

Ruttens, A., Boulet, J., Weyens, N., Smeets, K., Adriaensen, K., Meers, E., Van Slycken, S., Tack, F., Meiresonne, L., Thewys, T. et al., (2011). Short rotation coppice culture of willows and poplars as energy crops on metal contaminated agricultural soils. *International Journal of Phytoremediation* 13 (suppl), pp. 194-207.

Salt, D. E., Blaylock, M., Kumar, P.B. A. N., Dushenkov, V., Ensley, B. D., Chet, I., and Raskin, I. (1995). Phytoremediation: a novel strategy for the removal of toxic metals from the environment using plants. *Biotechnology* 13, pp. 468-474.

Singh S, Parihar P, Singh R, Singh VP and Prasad SM (2016). Heavy Metal Tolerance in Plants: Role of Transcriptomics, Proteomics, Metabolomics, and Ionomics. *Frontiers in Plant Science* 6, p. 1143.

Stritsis, C., Steingrobe, B., an Claassen, N. (2013). Cadmium dynamic in the rhizosphere and Cd uptake of different plant species evaluated by a mechanistic model. *International Journal of Phytoremediation* 16, pp. 1104-1118.

Van Slycken, S., Witters, N., Meiresonne, L., Meers, E., Ruttens, A., Van Peteghem, P., Weyens, N., Tack, F. M., and Vangronsveld, J. (2013). Field evaluation of willow under short rotation coppice for phytomanagement of metal-polluted agricultural soils. *International Journal of Phytoremediation* 15 (7), pp. 677-689.

Wei, S., Zhou, Q., Wang, X., Cao, W., Ren, L., and Song, Y. (2004). Potential of weed species applied to remediation of soils contaminated with heavy metals. *Journal of Environmental Sciences* 16 (5), pp. 868-873.

Wuana, R. A., Okieimen, F. E. (2011). Heavy Metals in Contaminated Soils: A Review of Sources, Chemistry, Risks and Best Available Strategies for Remediation. *International Scholarly Research Notices* 2011, 20 pages.