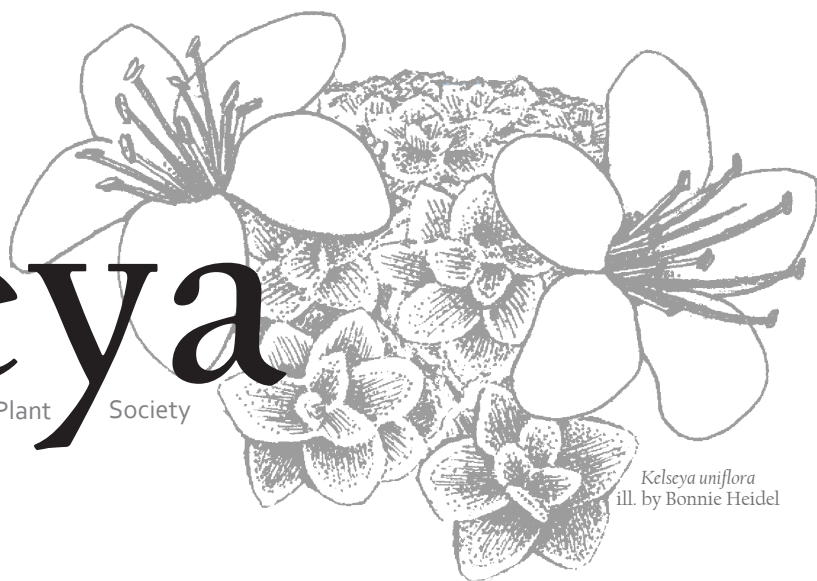


Kelseya

Newsletter of the Montana Native Plant Society



Kelseya uniflora
ill. by Bonnie Heidel

Natural History: Plants Defend Their Fungal Friends

By Peter Lesica, Clark Fork Chapter

The mycorrhizal symbiosis between vascular plants and soil fungi is one of the oldest and probably most common mutualistic relationship on earth. Soil fungi form exceedingly fine and far-reaching hyphal networks that can penetrate even the smallest openings between soil particles to extract nutrients such as phosphorus and nitrogen needed to make amino acids and proteins. Although soil fungi are great at acquiring mineral nutrients, they have trouble obtaining carbohydrates that supply the energy for growth. Plants have a hard time getting mineral nutrients because it's hard to make roots fine enough to reach all the nooks and crannies in the soil profile. On the other hand, most plants have an easy time making carbohydrates because two of the three main components, carbon dioxide and sunlight, are readily available above ground. Approximately 450 million years ago vascular plants and fungi figured it out—they could combine forces for mutual benefit, and the mycorrhizal symbiosis was born. Mycorrhizal fungi penetrate the roots of their plant host and deliver nitrogen and phosphorus through highly branched organs called arbuscules (Fig. 1). In exchange,

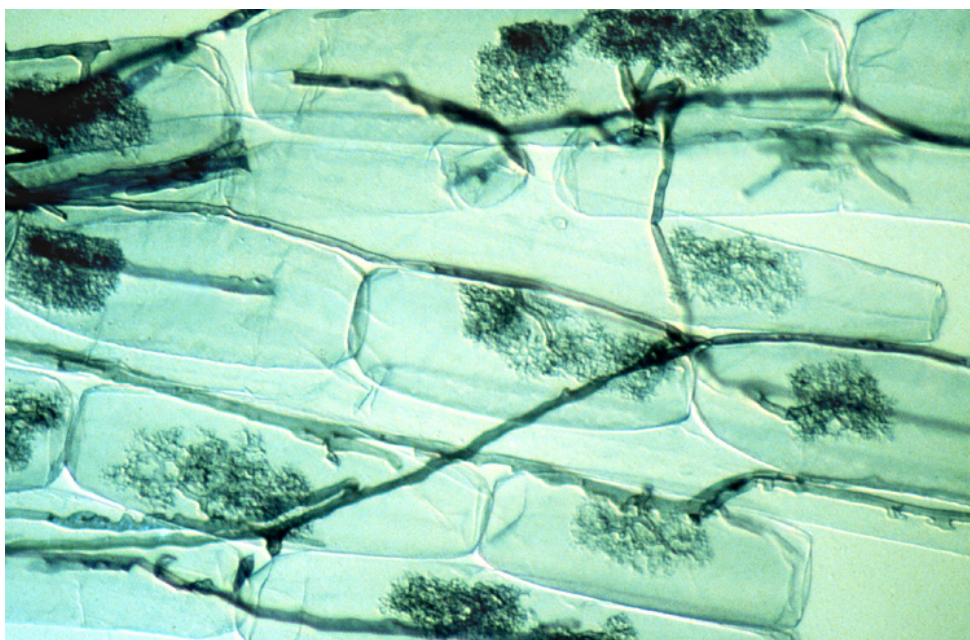


Figure 1: Mycorrhizal fungus forms arbuscules after penetrating the cells of a host plant's roots.
Photo by R. Antibus.

the fungal hyphae absorb carbohydrates from the plant cells they have penetrated. Everybody gets what they need most.

Telling Friend from Foe

Vascular plants have strategies to protect their ability to photosynthesize carbohydrates. Plants produce all manner of chemicals to deter, stifle or kill the animals that

continued on page 10

Chapter Events

Calypso Chapter

The Calypso Chapter is looking forward to an active 2014 season. We met for our annual Christmas brunch and planned for the New Year. Plus we recruited four new members! Keep posted about our activities on the MNPS web site and Facebook page.

Saturday, 4/5, time TBA. Annual Native Plant Workshop. MSU Professor Cathy Cripps will present a talk on "Wild Mushrooms in their Native Habitats." Mark your calendars and stay tuned for details! Info: Catherine at 498-6198, nativeplants@montana.com.

Clark Fork Chapter

Monday, 1/13, 7:30 pm. Ranch Manager Philip Ramsey will talk about the natural history and wildlife of MPG Ranch. This conservation property encompasses diverse habitats across more than 9,500 acres in the Sapphire Mountains. The presentation will explore the ranch's history, restoration efforts, plant monitoring and wildlife use. Rm 123, Gallagher Business Bldg, UM Campus. This is a joint meeting with Montana Audubon (**note different day and location**).

Tuesday, 1/28, 7:30 pm. Herbarium Night. They make great rock garden plants, and they attract butterflies! Join Peter Lesica for a look at "Montana's Wild Buckwheats (*Eriogonum*)."
Rm 303, Botany Bldg, UM Campus.

Thursday, 2/13, 7:30 pm. Robert Pal is a visiting professor of plant ecology from the University of Pecs in Hungary. He'll tell us about his home and "The Changing Flora and Vegetation of Hungary." Rm Log, Gallagher Business Bldg, UM Campus.

Thursday, 3/13, 7:30 pm. Sue Reel has been championing the cause of pollinators at Lolo National Forest. She wants to tell us "The Buzz About Bees & Other Pollinators and How to Attract Them to Your Native Plant Garden." Rm Log, Gallagher Business Bldg, UM Campus.

Tuesday, 3/25, 7:30 pm. Herbarium Night. This will be a work night. Come for an hour or two and help clean and put things in better order than they already are. Rm 303, Botany Bldg, UM Campus.

Thursday, 4/10, 7:30 pm. It's time to refresh your memory and get ready for summer. Come review some of your favorite wildflowers—and some you don't know, too—when Clark Fork Chapter photographers show slides of "Wildflowers from East of the Great Divide." Rm Log, Gallagher Business Bldg, UM Campus.

Flathead Chapter

Flathead Chapter meetings and programs are held the 3rd Wednesday of each month. Everyone is welcome to the business and work meeting at 5:30 pm. Programs begin at 7:00 pm. We meet at Teakettle Community Hall (aka North Valley Community Hall, North Valley Physical Therapy), 235 Nucleus Ave., Columbia Falls, unless otherwise noted.

Wednesday, 1/15. "Botanical Expeditions in Glacier National Park, 1909 and 1910." Using writings and photographs from botanists Morton Elrod and Marcus Jones, Rachel Potter will take us on two digital journeys through the early days of the Park. **Note change of location this month only:** Museum at Central School, 124 Second Ave. E, Kalispell. We are hosting a repeat of this popular program in gratitude to our Kalispell members who have been driving to Columbia Falls these past few years.

Wednesday, 2/12. "Wildflowers, Wild Places and Taming your Camera." Professional photographer Dee Linnell Blank travels the state of Montana seeking photogenic native plants. Come see and hear about some of her favorite locations, find out how to catch the bloom, and get tips for your own photos. **Note change of date:** We have switched this program to the 2nd Wednesday this month to avoid conflict with the Plant Conservation Conference in Bozeman.

Saturday, 2/15, 11:00 am. "Winter Shrub Identification Field Trip." Anne Morley and Betty Kuropat will lead a walk, ski or snowshoe along the Swan River Nature Trail in Bigfork to look at winter field characteristics of native shrubs. They will start with an indoor session to go over key characteristics of plants you can expect to see, and then head into the field. Participants will learn the basics of using a dichotomous key. Bring a lunch or plan for a late one at one of the restaurants in Bigfork. Bring water and appropriate field gear. Meeting place TBA when you RSVP to Anne at 886-2242 or Betty at 892-0129.

Wednesday, 3/19. "The Seduction of Art and Nature" with Dana Bush, artist and ecologist. To learn more about Dana's work, see this recent review at <http://fibre.acadnet.ca/wp-content/uploads/2013/11/ThreeVoices.pdf>.

Wednesday, 4/16. "Inseparable and Indispensable: Native Plants and Pollinators." Patti Mason, resource conservationist for the Flathead Conservation District, will teach us about the importance of pollinators, threats and their implications, major pollinator types and their needs during all life stages, and selecting plants to support pollinators. She will provide handouts and point us to numerous additional resources.

Wednesday, 5/21. Field trip TBA.



Kelsey Chapter

The Chapter needs one or more people to step up and help organize events and programs. Info: Kathy at drakekath01@gmail.com.

Maka Flora Chapter

Info: Libby Knotts at 774-3778, rek@midrivers.net.

Valley of Flowers Chapter

Meetings are held the 2nd Tuesday of each month from October through April at 7 pm in Rm 108, Ag Biosciences Building, MSU campus, unless otherwise announced. Info: Joanne at 586-9585.

Tuesday, 1/14. "Attracting and Conserving Native Bees Using Native Plants in Montana." Casey Delphia, research associate in MSU's Department of Ecology, will discuss the importance of native bees as pollinators, give an introduction to some of the more common types found in Montana and their biology, and describe some of the projects she is involved with that use native plants to foster native bees on farms and in the home garden.

Tuesday, 2/11. "Native Plants of Bighorn Canyon National Recreation Area: A Story of Biogeography." Cathie Jean, plant ecologist for the National Park Service Greater Yellowstone Inventory & Monitoring Network, will enlighten us about the unique flora of this area and how and why it occurs there.

Tuesday, 3/11. Speaker to be announced.

Eastern At-Large

Area representative Dave Shea (Choteau) reports that he's "already looking forward to next season's hikes." Two are planned for July; dates, times and meeting locations to be announced. One will be to Ear Mountain Outstanding Natural Area and Yeager Flats, the other to Preston Park in Glacier National Park. More details to come in the Spring and Summer issues of *Kelsey*. Info: Dave at 466-2161.

Western At-Large

Jon Reny (Libby) is working on activities for the year and would love to hear your thoughts. You can reach him at 334-0459, jreny@kvis.net.

Mark Your Calendar and Take The Survey!

Valley of Flowers Chapter members are excited to be hosting MPNS' 2014 Annual Meeting, titled "Fire and Ice." The get-together will take place June 27-29, and will be headquartered at Luccock Park Camp on Pine Creek, above the beautiful Paradise Valley. The camp is 13 miles south of Livingston and 55 miles north of Mammoth, Wyoming. This venue gives us access to a spectacular diversity of plant communities, from those developed on low-elevation basalts up to the alpine zone. The area is marked by classical glacial geology and has been impacted by wildfire several times in recent years, hence our meeting theme!

What should we offer during the meeting? Please help the VoF Chapter plan the best activities and hikes possible by taking the short online survey at <https://www.surveymonkey.com/s/gV5MQ78>.

Please respond no later than February 15.

P.S. The floral mascots this year will be silky phacelia and glacier lily.



Silky phacelia. Photo by Al Schneider, www.swcoloradowildflowers.com, used with permission.



Canvassing the Beaverhead-Deerlodge National Forest

By Jessie Salix

Historic monitoring data is not always available for sensitive plants, but in the case of Lemhi penstemon (*Penstemon lemhiensis*), interest by the Montana Natural Heritage Program and the US Forest Service in the 1980s and 90s spurred the establishment of several monitoring sites across the Beaverhead-Deerlodge National Forest. The establishment records for these sites were available, but relocating the transects after 20 years of vegetation change and no GPS information made the search more difficult. Several of them involved complex layouts and protocols.

That's how the idea for a Botany Blitz arose. All of the previous scientists involved in the establishment and reading of these sites still reside in the area: Steve Shelly, a former MtNHP botanist, currently is the Forest Service Region I Botanist. Bob Wooley and John Joy, previous Beaverhead-Deerlodge National Forest ecologists, are retired but still reside in the surrounding area. Last summer's Blitz was designed to bring these botanists and ecologists together with the current botanist and volunteers, in an effort to relocate and re-read these monitoring transects. A total of 17 people participated in the event, including the original scientists, the current botanist and her crew of four technicians, two Forest Service employees stationed elsewhere, and seven additional volunteers. This crew relocated a total of eight transects/quadrats and collected data during this event, which took place July 19 and 20, 2013. GPS location information was acquired at each site for future readings.

On our first day, participants formed two groups in an effort to "divide and conquer." A total of six transects/quadrats were visited and data collected. That evening we held an appreciation dinner, provided by the Montana Native Plant Society, to thank participants for their hard day's work and to chart their data for comparison with previous years. Most transects/quadrats had not been read in 13 years.

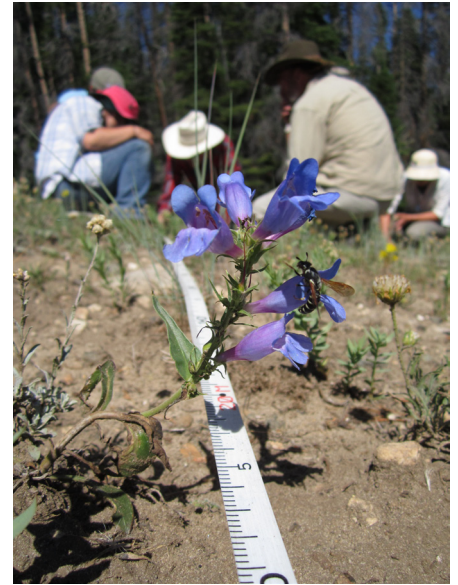
The second day of the Blitz involved locating and reading two historic quadrats, as well as re-assessing population counts for three Lemhi penstemon populations.

The 2009 Beaverhead-Deerlodge Forest Plan requires trend monitoring of all G1 through G3 sensitive plants. Lemhi penstemon is a G3 species. The data collected during the Botany Blitz will be valuable in assessing the overall trend of these populations.

The Botany Blitz was a huge success for all involved. The retired botanist and ecologists walked away knowing that their earlier work was still valuable to the agency, and were able to see how these populations currently are doing. The current botanist and crew were able to learn the various protocols involved in the monitoring projects, as well as record location information for future

readings. And volunteers became familiar with a rare endemic species of southwest Montana and were able to see their days' work charted up against previous years.

A big thank you to everyone who participated and to the Montana Native Plant Society for supporting this effort. The full Botany Blitz data report is now available on the MNPS website.



Lemhi penstemon and *Pseudomasaris vespoidea*, with data collection occurring in the background. Photo by Esther Brouwer.



Graphing of Day 2 data and looking at the overall Botany Blitz data for Lemhi penstemon. Photo by USFS staff.



Data collection in large quadrat. Photo by Esther Brouwer.



Dam Bear Grass*

By Caroline Kurtz, Kelsey editor

Last September, five sturdy volunteers ventured 11 miles out of Victor, MT, up to Mill Lake in the Selway-Bitterroot Wilderness. Our mission was to attempt a restoration project at the site of a recently-completed major dam renovation.

Peter Lesica and I participated on behalf of both the Montana Wilderness Association, the lead organization, and MNPS. Michael Dax came along as an intern from MWA, Claire Muller joined us from the Selway-Bitterroot Frank Church Foundation, and Bill Gosling was the US Forest Service Wilderness Ranger who thankfully packed in all the heavy stuff—100 beargrass and 20 spiraea plugs, picks, shovels, buckets, feed, not to mention our own food and tents—on his horse and two mules. He worked like a yeoman alongside us for two days, too.

The Mill Lake dam re-building had left a severely compacted and barren strip some 10 feet by 100 feet behind a new spillway. Our objective was to help jump start the natural filling-in process of the adjacent forest with plants started from seed at the US Forest Service Coeur d'Alene Nursery in Idaho.

Using recommendations from Joyce Lapp and Tara Luna, both former restoration specialists at Glacier National Park, the process turned out to be not as simple as just sticking plants in the ground, particularly for the beargrass. While some people broke their backs excavating appropriately-sized holes in the concrete ground, others of us got busy filling buckets with soft woody material from downed, decomposing trees and digging out dirt and bits of root from under nearby living beargrass. The idea is that this soil “innoculum” contains various microbes and mycorrhizal fungi beneficial to beargrass and will help give the young plants the best start when mixed with native soil from the excavated holes and the water-holding cellulosic material. As the soil mixture was ready, we took turns planting, trying to make sure the beargrass root crown stayed sufficiently above ground level to prevent rot. We finished with a layer of fine gravel around the base of the shoots. With practice, we got better at it as the day wore on.

Ultimately we planted 93 beargrass and about 10 spiraea plugs. According to Peter, we won't really know until next fall how our plants fared and how many have taken hold. I'd like to go back and find out! For me, this project was a fantastic experience. It gave me an opportunity to spend

time with interesting, motivated people and camp in a beautiful place for a couple of nights. I learned more about native plants, their needs and interactions, and about the natural history of Montana in general. And I got the satisfaction of doing work and accomplishing a goal.

The Montana Wilderness Association is interested in facilitating more such volunteer partnerships as a way to get small restoration projects done that tend to fall to the bottom of the priorities list due to a lack of time, labor and money. I've already put my name in for next summer. Perhaps you'd like to as well? If you're interested, contact Peter at lesica.peter@gmail.org for more information.



Mill Lake spillway. Restoration occurred between the spillway and the adjacent forest. Photo by Peter Lesica.



Before



After

Mill Lake planting site, before and after. Photo by Peter Lesica.

**I stole this title from Michael Dax' account of our trip, published in the September blog post of the Montana Wilderness Association. Michael's version is available at www.wildmontana.org.*



News & Notes



President's Platform: Are You A Member?

Did you know that the Montana Native Plant Society currently has more than 645 members and that 73 of these are lifetime members? Membership in the society entitles you to receive the Kelsey newsletter you are now reading, and gives you opportunities to participate in some incredible state and local-Chapter activities, including field trips, herbarium nights and inspiring lectures.

Most of us joined MNPS to learn more about native plants and to share a connection with others who value the conservation and preservation of Montana's native flora. Continuing your membership is a way to support the society's efforts to promote the study and use of native plants. As we approach the season of membership renewal, now is a great time to encourage your friends who also love native plants to join us. Information on becoming a member is available on the MNPS website at http://www.mtnativeplants.org/Join_or_Renew_Membership.

An example of a great membership opportunity is the upcoming Montana Plant Conservation Conference, February 19-20, at Montana State University in Bozeman. The theme of the conference is pollinators. I hope to see you there.

There is also a brand new MNPS Facebook page at www.facebook.com/MTNativePlantSociety with information on upcoming events around the state. To make this site more useful we encourage you to send information and photos you would like posted to Clare Beelman (clare.beelman@gmail.com). We would especially appreciate information on great hikes, where wildflowers are blooming and of course photos of plants you encounter as you hike. This is also a great way to advertise local Chapter events. You do not have to be a member of Facebook to check out the site. We hope this will be an effective way to connect with members throughout the year. Oh yes, don't forget to "like" us!

— Kathy Settevendemie

MNPS Small Grant Competition

The Montana Native Plant Society (MNPS) announces its 18th annual Small Grant competition for projects or studies that support the following objectives: 1) stimulate research, conservation and educational activities that help foster an appreciation of Montana's native plants and plant communities; and 2) promote native plant conservation through better understanding of Montana's native flora and vegetation and the factors affecting their survival.

The competition is open to residents of Montana and to all members of the MNPS. **The deadline for proposals is February 14, 2014.** Project or study proposals must pertain to native plants of Montana. All proposals that meet the minimum criteria will be considered, however proposals are sought that generate data or public support for conservation of native plants in the wild. For more information see the Montanan Native Plant Society website or contact Dr. Linda Lyon, l_lyon@umwestern.edu.

Welcome New Members!

The Montana Native Plant Society welcomes the following new members:

Calypso Chapter:

Byron Clark

Clark Fork Chapter:

Sharon Dill, Roberta M. McElroy, Marilyn Wolff, Carol Evans, Terra Parchen and Wendy Ninteman

Flathead Chapter:

Teresa Geyer Stump and Karen Hinman

Kelsey Chapter:

Suzi Holt

Valley of Flowers Chapter:

Perry Miller and Peter Romatowski

State Western-At-Large:

Linda Sue Tice



Conference Reminder

The Northwest Scientific Association's annual conference, jointly sponsored by the UM College of Forestry & Conservation-Plum Creek Lecture Series, Montana Wetland Council, the US Forest Service and Northwest Lichenologists, is coming to the University of Montana in Missoula, March 26-29, 2014.

This conference will provide a great opportunity to present your research and share ideas with scientists from throughout Northwestern North America. You can find submission details and registration information at <http://www.northwestscience.org/>.

Do You Like Us?

Never let it be said that MNPS is not living in the 21st century. The statewide organization now is on Facebook. Chapters can easily communicate with each other about events, state-wide topics and other pertinent information via the page, and non-members have another way to find out about who we are and what we do. Find us at <https://www.facebook.com/MTNativePlantSociety>.

You can also follow individual chapters; the Clark Fork Chapter has its own page at <https://www.facebook.com/MNPSClarkForkChapter> and other Chapter pages will be coming soon.

For information about MNPS and Facebook, contact Clare Beelman at clare.beelman@gmail.com.

Lemma Tell Ya About The Grass Class

By Patrick Plantenberg, Kelsey Chapter

Several people commented after the 2012 Annual Meeting that they would like to see a formal education component at MNPS Annual Meetings. In response, Kelsey Chapter organizers asked Matt Lavin, agrostology professor at MSU, to conduct a "glume-y" four-hour grass class as part of the 2013 Annual Meeting last summer. More than 40 people registered for the free class, held from 1 to 5 p.m. on Friday afternoon, surprising everyone—including Matt.

The class was graciously hosted at Harvey and Sheila Bjornlie's summer residence near Niehart. The weather was beautiful and the students were enthusiastic. Matt came well-prepared and taught the basic taxonomic characteristics of 20 plus common pressed-grass species.

The formal lecture part of the class was followed by a field trip through the lovely mountain meadow surrounding the Bjornlie' residence. All participants received a certificate of course completion. Many thanks again to Matt for teaching the class.

Will there be another educational class at next year's annual meeting? The Valley of Flowers Chapter is hosting the 2014 Annual Meeting in the beautiful Paradise Valley south of Livingston. Let them know whether you would like another educational opportunity in 2014.



Matt Lavin instructs participants in the grass class. Photos by Patrick Plantenberg.



Small Grant Report: Weed Control on Mount Sentinel

By Kathy Heffernan, Science Teacher, Sentinel High School

Sentinel High School biology students spent three afternoons last April and May first counting, then pulling and cutting spotted knapweed and leafy spurge in weed study plots located in the North Hills area of Missoula. After sampling the area in Fall 2012, the students determined that there was a weed problem on the Peschel Conservation Easement in the North Hills (an average of 2.3 knapweed stalks and 30 leafy spurge stalks per square meter).

Rattlesnake Land Trust, which oversees the conservation easement, selected an area for weed study plots. Each group of two to four students "adopted" a 10x10 meter plot and planned control methods for their plot. Control methods included cutting leafy spurge, cutting or pulling spotted knapweed, seeding with native wildflowers and grasses, and adding beneficial insects. After research and listening to guest speakers, the student groups selected combinations of *Gaillardia*, *Cerastium*, *Clarkia*, goldenaster, *Monarda*, yarrow and Idaho fescue. Students also chose knapweed root weevils (*Cyphocellus achates*) and leafy spurge flea beetles (*Aphthona nigricornis* and *Aphthona lacertosa*) to release on the site. Unfortunately, these insects were not available until summer, but local 4H members stepped up to release the insects in August.

In the classroom, the students learned about weed control and native plants from Bryce Christiaens, Missoula County Weed District and Native Ideals Seed Company, and Kathy Settevendemie, Blackfoot Native Plants Nursery. The students learned to identify noxious weeds and common local wildflowers.

In Fall 2013, a new group of high school students visited the plots to count the spotted knapweed and leafy spurge; their data are preliminary. Students selected two, random square meters in each of the six plots for counting by throwing our garden-hose-and-duct-tape "random sampler." The students will take more extensive data in Spring 2014 to match the springtime data taken by the previous classes.

The preliminary results have yielded some surprises. Leafy spurge appears to have been significantly impacted by the clipping in plots 1-5. The average difference between spring counts and fall counts in the five plots was 53.92 plants. In Plot 6,

herbicide was applied by adults during late spring. The difference in Plot 6 was 23 plants between spring and fall

data.

Spotted knapweed appears not to have been significantly impacted by the clipping in Plot 1, the pulling in Plots 2-5, or even the herbicide application in Plot 6. The average difference in Plots 1-5 was negative 2.2 plants, meaning that there was an average of 2.2 more plants per square meter than were there to begin with! In Plot 6, the difference was -1.2 plants. This may be due to the timing of the growing season of knapweed or seed bank in the soil or both.

Missoula Conservation Lands manager Morgan Valliant reported that our data are similar to results at a nearby site. The City of Missoula has been using sheep to control leafy spurge for the past decade on Waterworks Hill Open Space. Grazing has had significant effect on the spread of leafy spurge, but little impact on knapweed.

In Spring 2014, the classes will return to the site to (1) take more measurements, (2) check for native plants that were seeded last spring, (3) continue control efforts. Students hope to add the use of grazing by sheep to their weed control efforts.

The students wish to thank the Montana Native Plant Society for funding this project. The Small Grants program provided funding for field trips, tools, seeds and beneficial insects. In addition, the students are grateful for the assistance of Kathy Settevendemie (MNPS), Bryce Christiaens (Missoula County Weed District), Kandace Rich (WeedBusters), Janice Sproull (Rattlesnake Land Trust), Ryan Chapin (Five Valleys Land Trust), Morgan Valliant (City of Missoula) and John Heffernan (volunteer).



Sentinel High School students count spotted knapweed and leafy spurge. Photo by Kathy Heffernan.



Small Grant Report: Leaky Moss

By Mandy Slate

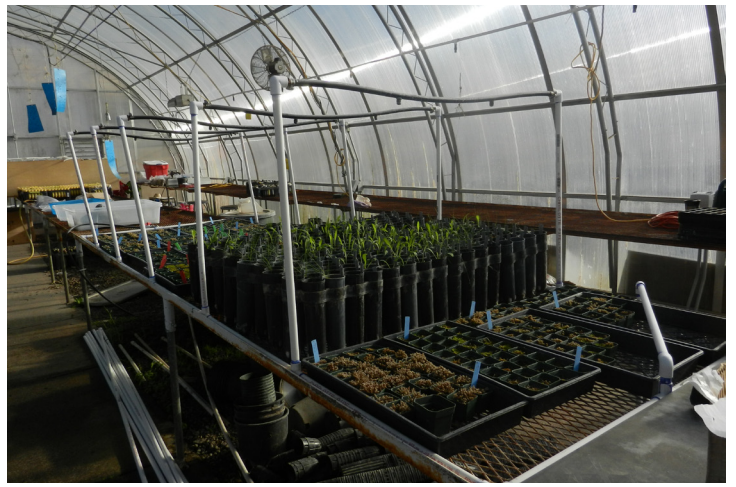
Generally when ecologists refer to interactions that link the above-ground plant community with below-ground, soil-dwelling organisms, moss does not enter their mind. After all, mosses don't have roots, they are very small and, in many ecosystems, are so hard to see that they're assumed to be mostly absent. With the help of funding from the Montana Native Plant Society's Small Grants Program, I am working to challenge this paradigm and clarify a few of the ecosystem services provided by these diminutive organisms.

Mosses differ greatly from most other plants in some of their basic physiological processes. Vascular plants depend on roots to mine for water, which begs the question: without roots how do mosses stay alive? Harboring as much generic diversity as plants ten times their size, mosses vary from being incredibly tolerant of dry conditions (for example, those mosses you find in our intermontane grasslands) to being absolutely intolerant of wet/dry cycles (as in the case of aquatic mosses). My interest revolves around the mechanisms, responses and consequences of moss rehydration following desiccation, and thus I will focus this article around those mosses that excel in drier conditions.

When mosses dry out, their cells shrink, contorting and compressing, which causes the entire plant to shrivel. Photosynthesis and respiration slow nearly to a halt as the plant essentially becomes dormant. Mosses can wait like this for a long time. As soon as rain returns, the cells swell, contorted leaves unfold and, in some species, metabolic activity returns within minutes. With leaves often only one cell thick, mosses generally do not have stomata or cuticles to help govern hydration, unlike vascular plant leaves. Instead, water moves easily in and out of these tiny leaves via simple diffusion, causing the extreme fluxes in growth and dormancy mentioned above.

Rehydration happens so quickly in mosses that their cell walls break in numerous locations. Within ten minutes or so, depending on the species, those walls are rebuilt and the moss is renewing its carbohydrate stores in preparation for the next drying episode. During that short gap of time, something amazing happens.

The moss's ruptured cells are unable to contain their precious store of internal solutes (carbohydrates, amino acids and ionic compounds), which leak out until cellular integrity is restored. What happens to all of those sugars? Previous research has looked most closely at this phenomenon in the confines of a petri dish. In a petri dish, these little photosynthetic sponges eventually reabsorb all of their lost resources. In nature, the battle for free carbon is much more intense. With the onset of a precipitation pulse, the soil microbial community is reactivated and renews its processes of decomposition and mineralization. In this highly active setting, it is unlikely that moss would have more than a second to retrieve its lost resources—and a second just doesn't cut it. Research has suggested that



Watering system for propagation of Montana mosses research. Photo by Mandy Slate.

vascular plants will intentionally situate their roots in areas where they expect to receive predictable nutrient pulses or places that will stay hydrated for just a bit longer, like under a rock or in a dry stream bed (or perhaps under moss). Some previous research has even traced the transfer of leaked moss nutrients, leachates, to nearby plants via fungal mycelia.

As well as trying to collect and describe these leachates, I am also interested in how they may be interacting with both the above- and below-ground communities to determine ecosystem processes and community dynamics. These processes have been heavily studied in the northern boreal forests and tundra, which are often dominated by mosses. In our intermontane grasslands, mosses do not form a large part of the above-ground biomass. However in our nutrient-limited ecosystem, temporal pulses of nutrients may have an even greater effect on processes like nutrient cycling and plant establishment.

Boreal mosses have been found to harbor nitrogen-fixing bacteria, exert strong controls over soil (its chemistry, hydrology, temperature, hydration, fungi and microbes), and both facilitate and compete with vascular plants. A fair amount of grassland research has examined the effects of mosses on plant regeneration, which are generally positive in drier environments like ours. Conversely, very little work has addressed the function of mosses in below-ground interactions in semi-arid grasslands. In consideration of the strong influences mosses have in boreal ecosystems, I will utilize my MNPS Small Grant Funds to improve our understanding of the intricacies of interspecific interactions within ecosystems that are mediated by bryophytes, thereby furthering an awareness of the significance of this often overlooked group of native plants.

Despite their resilience in nature, mosses can be a challenge to grow. Prior to 2013, I managed and cultivated many species of moss for researchers at Portland State University. I learned, through this experience, that I need a specialized watering system to satisfy these small plants. I am grateful to MNPS for providing the funding to purchase supplies needed to construct this watering system for my PhD research. I am now successfully growing the Montana mosses, which will soon undergo the various drying and rehydrating cycles required to extract the bryophyte leachate for analyses.



would eat their leaves, stems and seeds. But what about the plant's symbiotic fungal partners in the soil? There are many soil insects that eat fungus and these insects can damage mycorrhizal fungi, lowering their ability to gather nutrients for their vascular plant partners. Plants defend their own tissues from enemies, but do they protect the fungal partners that gather nutrients for them? This is the question that Marie Duhamel and her collaborators recently reported on.

English plantain (*Plantago lanceolata*) is a common plant in Europe, where it is native, and in North America, where it has been introduced. It is dependent on having a fungal partner and has been shown to produce several defensive chemicals, including catapol, a chemical that deters feeding in many herbivorous insects. Duhamel et al. grew English plantain in pots with and without mycorrhizal fungi and with or without springtails, tiny soil-dwelling, wingless insects, many of which feed on fungal hyphae (snow fleas are one type of springtail). They grew the plants for three months and then harvested them. They found that plantain grew more than 50% better in the presence of the fungal symbiont, but half of this positive effect was lost in the presence of springtails. So when the mycorrhizal fungus was attacked by springtails, the host plants did indeed suffer. More importantly, the researchers found that the hyphal mass of the mycorrhizal fungus contained catapol, but only when the springtails were present. This defense chemical must have come from the host plant because the fungus is not capable of making it. Taken together, these results suggest that when springtails are eating its mycorrhizal fungi, the plantains provided a chemical defense to directly help the fungus and indirectly help themselves by deterring herbivory. The host plants came to the rescue of their fungal partners by providing



Figure 2: A soil springtail approx. 1 mm long. Photo by D. BanDrosky.

chemical weapons in the presence of hungry fungivores.

But this isn't the end of the story. In some cases the host plant does more than just help its mycorrhizal fungal partner deter its enemies. John Klironomos and Miranda Hart found that springtails actually are killed by eating *Laccaria bicolor*, a mycorrhizal fungus which then, in turn, eats the insect and transfers part of the nitrogen to its host plant, eastern white pine (*Pinus strobus*). The host plant turns its fungal partner into a "hit man" and then reaps the rewards. It may be that there are more carnivorous plants out there than we imagined.

Further reading

Duhamel, M et al. 2013. "Do fungivores trigger the transfer of protective metabolites from host plants to arbuscular mycorrhizal hyphae?" *Ecology* 94: 2019-2029.

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MNPS Chapters & the Areas They Serve

CALYPSO CHAPTER - Beaverhead, Madison, Deer Lodge, and Silver Bow Counties; southwestern Montana

CLARK FORK CHAPTER - Lake, Mineral, Missoula, Powell, and Ravalli Counties

FLATHEAD CHAPTER - Flathead and Lake Counties plus Glacier National Park

KELSEY CHAPTER - Lewis & Clark, Jefferson, and Broadwater Counties

MAKA FLORA CHAPTER - Richland, Roosevelt, McCone, Sheridan, and Daniels Counties

VALLEY OF FLOWERS CHAPTER - Gallatin, Park, and Sweet Grass Counties plus Yellowstone National Park

All MNPS chapters welcome members from areas other than those indicated. We've listed counties just to give you some idea of what part of the state is served by each chapter. Watch for meeting announcements in your local newspaper. Ten paid members are required for a chapter to be eligible for acceptance in MNPS.

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The Montana Native Plant Society (MNPS) is a 501(c)(3) not-for-profit corporation chartered for the purpose of preserving, conserving, and studying the native plants and plant communities of Montana, and educating the public about the value of our native flora. Contributions to MNPS are tax deductible, and may be designated for a specific project or chapter, for the Small Grants fund, or the general operating fund.

Your yearly membership fee includes a subscription to *Kelsey*, the quarterly newsletter of MNPS. We welcome your articles, field trip reports, book review, or anything that relates to native plants or the Society. Please include a line or two of "bio" information with each article. Drawings should be in black ink or a good quality photocopy. All items should be typed, saved in Microsoft Word or rich text format (rtf), and sent electronically to: carokurtz@gmail.com or mailed to Kelsey Editor, 645 Beverly Avenue, Missoula, MT, 59801.

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