



**Rocky Mountain
Biological Laboratory**
Science at the Top
Fall Newsletter 2011



Dear RMBL Members, Friends, and Community,

What does it mean to open RMBL up to the larger world? In a very narrow sense it involves dealing with the increasing numbers of people passing through the valleys and working to enlarge our community of supporters in order to provide needed resources for education and research. In a broader sense, outreach and education is a conversation between scientists and the public. Both the public and the scientists have the opportunity to learn from each other. When done well, outreach makes the science better.

How is it that scientists learn from engaging with the public? The ability to present complex science requires scientists to really understand their material. Often the process of translating science to people outside the field deepens the understanding of the experts; scientists are forced to think carefully about what they are studying and why. Consequently, education is not just about training but also about discovery.

In 80+ years of training undergraduates we have learned that observant undergraduates see the world with new eyes; details jump out that experts overlook. Good students are not afraid to ask basic questions that scientists have set aside, but for which answers have not truly been worked out. Several major RMBL research programs initially started from observations made by undergraduates. Education can drive exploration and discovery. For example, a long-term research project on the sex lives of geranium plants grew out of an observation by a student in a field ecology course.

The importance of education to science is not limited to training college students. Anybody can offer fresh eyes and questions. This year we ran a week-long citizen science course that targeted adult learners and that focused on climate change. Dave Gutzler, a lead author for the 2013 International Panel on Climate Change Report, joined RMBL scientists in meeting with 8 participants. Our citizen scientists listened in on the scientists discussing their experiences with the science of climate change, followed scientists in the field, and had the opportunity to make their own observations and ask questions. I found the success of the program very exciting and look forward to similar offerings in future years. The more people that truly understand the value and sheer joy involved in discovery of the world around us, the more support there will be for field science. And perhaps more importantly, it will only enrich the science to have more people involved in exploring the valleys around Gothic.

Whether you are a college student or a citizen scientist, keep your eyes out for our programs next year. You can be part of a community of scholars engaged in exploration and discovery that informs how we know the world!

Sincerely,

Ian Billick, Ph.D.
RMBL Executive Director

Photo of ant *Formica* sp. on a Mule's Ear sunflower (*Wyethia amplexicaulis*) by Dr. Noah Whiteman

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Cover photo by Benjamin Blonder. King's crown (*Sedum integrifolium*) coming up in a snowmelt marsh on the north ridge of Gothic Mountain.

RMBL Falls News 2011

Development

Profiling Tricia Nichols, a RMBL Citizen Scientist

Contributed by: Meike Meissner

This past August the Rocky Mountain Biological Laboratory introduced its inaugural Citizen Scientist course, hosting eight enthusiastic participants and a dozen scientists to discuss the title topic, *The Biology of Climate Change*. For five days participants immersed themselves in the life of Gothic's researchers – eating in the dining hall, listening to lectures, trapping marmots, gathering field data, fostering glacier lilies, and joining a panel discussion that sparked lively debate between scientists and students.

One of the participants was Tricia Nichols, a Denver resident who initiated this advanced adult science education course in Gothic. As to the impetus of the course formation Tricia said, "Who doesn't enjoy experiencing a sense of awe or wonder? We see it in the faces of children but often lose access to it in our 'grownup' world. Yet such experiences are immediately available, in nature, to everyone if scientists/ecologists invite them in to learn in a manner that is accessible, tantalizing, intriguing, non-threatening and FUN! Who benefits? Those who learn will be delighted and our delicate planet might still have a shot at continuing to provide us with a life worth living."

When asked how she became involved in RMBL, Tricia exclaimed, "One can only hike from Aspen to Crested Butte so many times before wanting to move past just seeing the glorious flowers. I wanted to know more. Why do the flowers differ at varying altitudes along the way? Why do they have different colors and shapes? Who's pollinating them? What role do gophers and marmots play? And who could teach me these things without my having to be a matriculating student in a city university?! Again and again, the environmental groups I contacted told

me that RMBL was the place to learn." Last winter she began corresponding with RMBL staff on how to fulfill this vision and the Citizen Scientist program was born.

After spending a full week in Gothic with RMBL scientists, Tricia was moved to underwrite a portion of the Citizen Scientist course and to support the research of the scientists that participated. She found that she was "most impressed by the passion and earnestness of the scientists who took their valuable time to teach a group of neophytes. There was nothing doctrinaire about their approach. They truly wanted to share with us what they have learned from decades of exhaustive research. There was a delicacy and humility about their instruction that left us all feeling honored to be in the class. I so admire the honesty and the tenacity of their endeavors that I wanted to show my gratitude by offering some financial support."

Next year's RMBL Citizen Scientist course is scheduled for July 30 - August 3, 2012 and the topic on the table is *The Biology of a Changing World*. Portions of this program are open to the public and will have a wide range of activities and topics. For more information please contact Allison Butcher at (970) 349-7420, or email her at allison@rmbll.org.

As Tricia summarized best, "The seminar reminded me that our culture teaches us to focus on accumulation of wealth, on consumption of natural resources and energy, to our own detriment and the detriment of our delicate world. With classes that RMBL teaches, to both children and adults, we are emboldened to become willing and enthusiastic stewards of our home - our planet."



Citizen-scientist participant Tricia Nichols exhumes a glacier lily bulb from a pot in instructor James Thomson's outdoor "transplant garden." The bulb was then photographed and measured. Annual measurements going back to 1991 document the response of these long-lived perennial plants to climatic fluctuations and the stresses of reproduction.

Research

Researching the Role of Fungal Endophytes in Colorado Grasses

Contributed by: Jennifer Rudgers, PhD

Research on the role of fungal endophytes at the Rocky Mountain Biological Laboratory has the potential to help farmers and ranchers in flood-prone areas. For the past three years Dr. Jen Rudgers and her team have been studying Colorado grasses and the micro-organisms, endophytes, that help plants under stress.

Almost every plant has microbial symbionts, a form of bacteria or fungus that lives within the plant without causing it harm. Most plants are helpless without endophytes, which are both taxonomically and functionally diverse. They include such groups as nitrogen-fixing bacteria and mycorrhizal fungi, both of which can increase access to nutrients in the soil, and other, more generalist rooting zone organisms, such as plant growth promoting endophytes, which colonize the aboveground parts of plants.

Fungal endophytes are among the least well known and their basic ecology remains a mystery. Rudgers has been based at the Rocky Mountain Biological Laboratory for the past three years conducting the first survey of the biodiversity of fungal endophytes in Colorado grasses. Fungal endophytes grow in the aboveground parts of plants (leaves, stems, seeds), but do not produce any symptoms of their presence. To find them you need a good microscope or the ability to extract their DNA from the host plant.

Grasses don't usually have many of their own chemical defenses to aid in protection against herbivores. However, by forming symbioses with endophytes, grasses have acquired several different types of alkaloid compounds which can provide resistance to herbivory. These include the ergot alkaloids, lysergic acid derivatives that are toxic to mammals, and the loline alkaloids, which can deter insects.

Endophytes can also increase plant performance under drought and other environmentally stressful conditions, which make these fungi very attractive to plant breeders. Endophytes may be a great way to enhance the drought and herbivore resistance of grasses that are used for turf, forage, restoration, and re-vegetation. Improvements to these grasses can be made through the discovery of new species

of endophytes, combined with experiments to understand how they affect the ecology of their host plants in nature.

Rudgers' research has already turned up some new species of fungi from Colorado grasses, including a fungus in the woodland grass, Richardson's brome (*Bromus richardsonii*), and another species in the common meadow and forage grass, Thurber's fescue (*Festuca thurberi*). This summer, along with undergraduate student Catherine Debban, she started experiments to better understand the ecological consequences of endophyte symbioses.

"We tested whether the presence of a fungal endophyte in marsh bluegrass (*Poa leptocoma*) enhances its ability to coexist with a closely related and ecologically similar species, nodding bluegrass (*Poa reflexa*)," said Rudgers. Nodding bluegrass appears to lack endophyte symbiosis, according to their survey of sites across Colorado. Classic coexistence theory in ecology posits that when species have very similar niches, one will out-compete the other. However, the acquisition of a microbial symbiont could shift the niche of a plant host in ways that facilitate species coexistence.

To test this hypothesis, Rudgers' team experimentally eliminated the endophyte from a subset of marsh bluegrass seeds and plants and compared their performance in field sites representing the ecological niches of both bluegrass species.

With the endophyte, marsh bluegrass had higher germination and growth in much wetter sites than nodding bluegrass. When the endophyte was removed, the germination and growth of marsh bluegrass was better in sites occupied by nodding bluegrass than when the endophyte was present. Together, these results lend support to the hypothesis that symbiosis shifts the host niche in a way that promotes species coexistence.

Rudgers concluded, "We will be tracking the plants for at least another year to get a more complete picture of their ecology. We are curious about whether this endophyte may be providing some protection against plant stress caused by flooding, which would represent a novel ecological benefit of endophyte symbiosis, and have the potential to help farmers in flood-prone areas."



Typical stream-side niche of marsh bluegrass, *Poa leptocoma*. Photo courtesy: Dr. Jen Rudgers

Education

Undergraduate Student Profile

Martha M. Villalobos, University of Arizona

What inspired you to spend a summer at RMBL?

I had been working at Dr. Noah Whiteman's Lab at the University of Arizona and he was the first one who told me about RMBL and life in Gothic, encouraging me to apply. I was actually very nervous to apply as I had never done any field research before and really felt that RMBL was out of my reach. The opportunity to take a class and create my own research project was too amazing to pass by! I was awarded a full scholarship that is annually funded by Ryan's Run, a memorial race held in St. Louis every September to honor the memory of Ryan Brown, a RMBL student who died in an accident on Gothic Mountain in 2000.

What sort of work did you do?

In the lab at school, I studied the morphology of *Drosophila melanogaster* and *Scaptomyza flava* fly brains, but being at RMBL was my first real opportunity to do field research and it was a great experience. I was looking at the host interaction with *Scaptomyza nigrita*, a fruit fly, and its host plant *Cardamine cordifolia*, a mustard plant that grows along montane streams in western North America. Specifically, I was looking at whether the fly's feeding preferences would be affected by having its host plant be infiltrated with different plant hormones and bacteria. I found through my research that there was a significant difference in feeding by the fly, when it was given the choice to choose which plants to feed on. They specifically avoid plants that were infiltrated and induced with jasmonic acid, a plant defense hormone, which is induced by plants when undergoing herbivory by insects.

What was your biggest "take away" from this work?

As I had only ever worked in a lab, looking at fly brains and creating images on a computer, I was a bit intimidated by actually having to go out into the field. I was really worried about my ability to do meaningful field work., but I learned that I *can* do research! I was very excited to realize this and also very inspired to have other researchers, especially Noah and Parris Humphrey, my other mentor, tell me

that I was doing a good job and providing beneficial advice. I learned that field research is really important and being able to interact with a species in its own environment makes you think in different ways about your research, forces you to change tactics, and gives you a better perspective on your study subject.

Being around so many great field scientists was inspirational too – everyone was very supportive and incredibly nice. One of the biggest differences between RMBL and my school was that all of these famous and successful scientists were very approachable and down-to-earth. Everyone in Gothic loves science and it is a place where I felt immediately at home.

Tell us a little bit about yourself.

I am originally from southern California and am the oldest of five children. I am also the first person in my household to attend a university so this is uncharted territory for me and my family. I am double majoring in molecular cellular biology and biomedical sciences, aspiring to become a pediatrician. After this summer in Gothic though, I think that I would like to ideally pursue an MD/PhD so that I can concurrently combine medical training with scientific research.

My scholarship from the Brown family in honor of their son, Ryan, motivated me at a personal level as I too have

lost a brother, and having people honor the memory of a loved one by providing an educational opportunity at RMBL is an amazing thing. Without the scholarship I would not have had this chance to live and work in this beautiful place – and I would like to thank them again for what has been a truly life-changing experience for me.



Martha Villalobos collecting flies with an insect aspirator at the outflow of Emerald Lake this summer. Photo by: Dr. Noah Whiteman.

History

40 Years in Gothic... Some Memories

Contributed by: billy barr

billy barr has a BS in Environmental Science from Rutgers University and first came to RMBL in 1972 as part of a water quality study. He stayed on afterwards to do an assortment of jobs including cleaning, library work, plumbing, electrical, phone line work, and all the dishes for four years, as well as being on the fire fighting crew. In 1980 he began working in RMBL's Business Office and he continues to live year-round in Gothic, doing the weather and avalanche work for various organizations. He is known for a mean game of cricket and having a penchant for chocolate.

It is hard to sit down and think about my 40 years at RMBL in terms of one brief article. The life out here in Gothic, as well as my relationship to it, changes over time and each year is different. This is a beautiful area but it can be harsh – survival of animals is brutal, especially in winter.

That being said, my first memory of Gothic was my very first morning, when, after getting in during the night, I awoke to look out the big picture window of Red Rock Cabin and saw Gothic Mountain for the first time. Almost knocked me over! I remember quite clearly later that fall sitting on the ridge above Copper Creek off of Virginia Basin, realizing that it would have been my first weekend back at college, and instead of being depressed I was up above the changing aspens and felt great, knowing that I would be staying for a while (although at the time I had no idea how long).

In more recent years I remember living with a pine marten for three winters, which was easily my most interesting Gothic animal adventure. The two of us grew used to each other and had an easy relationship so that I would be out in front of the old cabin I lived in at the time and she would sit on a stump or on the snow and watch while I cut wood. She lived in the back room of the old shack I was living in and would come and go at her leisure (usually at night). I thought it was nice (the companionship) and very interesting as pine martens are normally very solitary animals. However, the third winter she lived with me she had a young one with her

that whined all winter long, every night, and she would growl back in response – that was not so enjoyable in the middle of the night. After that winter she was gone, never to return.

While I track the weather and collect data daily, the big storms dominate my weather memories, those with more than 100 inches of snow in a week. I remember once taking 30 minutes to ski from my house to work because the snow was so deep it was hard to move, and another time I gave

up and turned around. One storm triggered 16 avalanches across the road between Gothic and the trail-head, and one time a slide ran off of Gothic Mountain and reached the Ore House cabin just minutes after I had been in there (this was before I had my solar setup and had to keep a radio in Ore House to call in the avalanche information every morning).

My life in Gothic is pretty routine now. I wake up well before light, lie in bed and listen to the radio. Then I get up and post the weather, eat, and go to work all day at RMBL. In the evenings I eat, read, and watch a movie. I used to write letters every night but that is far less frequent now that the internet is here. On the weekends, I hike in the summer and ski in the winter. I like basins, not peaks, and my favorite is Pika Basin, but I like them all up Copper Creek and in Rustler's Gulch.

It sounds trite, but the one great constant of living in Gothic and working at RMBL is how great

the people who come here are, summer after summer. Smart, nice, active and fun! RMBL has gone through various cycles over my time here, from the days of Chris Johnson through the directorships of Pete Brussand and Andy Beattie, when RMBL became more tech friendly. Some changes I have liked, others not, but the people who come here are what keeps me going in the summer (as well as, usually, the long gentle winter alone!). But really, in many ways, it is the day-to-day living in Gothic that is not memorable and does not stand out at all that remains my favorite memory of this place.



The inestimable billy barr in hiking into Queen's Basin on August 21, 2011 with White Rock Mountain in the background. This winter billy will be celebrating 40 years in Gothic. Photo by: Will Petry.

2011 Snapshots



Photo by: Howard Whiteman

Above: What happened to spring? Dr. Howard Whiteman, Morgan Geile, and Ashley McQueen standing in front of Pond 12 at the Mexican Cut Nature Preserve on June 21, 2011, when all of the ponds were still almost completely frozen. **Below center:** When the snow finally did melt, the wildflowers were spectacular



Photo by: Sarah Rudeen

Above: Dr. Noah Whiteman discusses host-parasite interactions as part of RMBL's Exploration Experiences, a series of science tours for adults that are held every Thursday throughout the summer. For more information on next summer's schedule, please email enviro-ed@rmbll.org or visit www.rmbll.org.



Photo by: Meike Meissner

Above: As part of a multi-year project on the effects of rainfall on the fitness of closely-related species, Christina Feng emasculates Scarlet Gilia flowers, individuals of *Ipomopsis aggregata*, *Ipomopsis tenuituba*, and their hybrids to prevent gene flow with local populations. **Below:** GLORIA (Global Observation Research Initiative in Alpine Environments) research assistant Marilyn Krill.



Photo by: Sarah Rudeen



Photo by: Will K. Peiry

Above Right: Scott David holding a garter snake (*Thamnophis ordinoides vagrans*) that he caught at a Brush Creek field site in June.

Below: Kids Nature Camp Leader, Lizzy Plotkin, teaching the Wonderful Journey of Water and Aquatic Life Study at the Kettle Ponds. The kids used nets to capture and then observe macro-invertebrates, tadpoles, salamander larvae, and adult tiger salamanders.



Photo by: Kathy Darrow



Photo by: Annie Starr



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