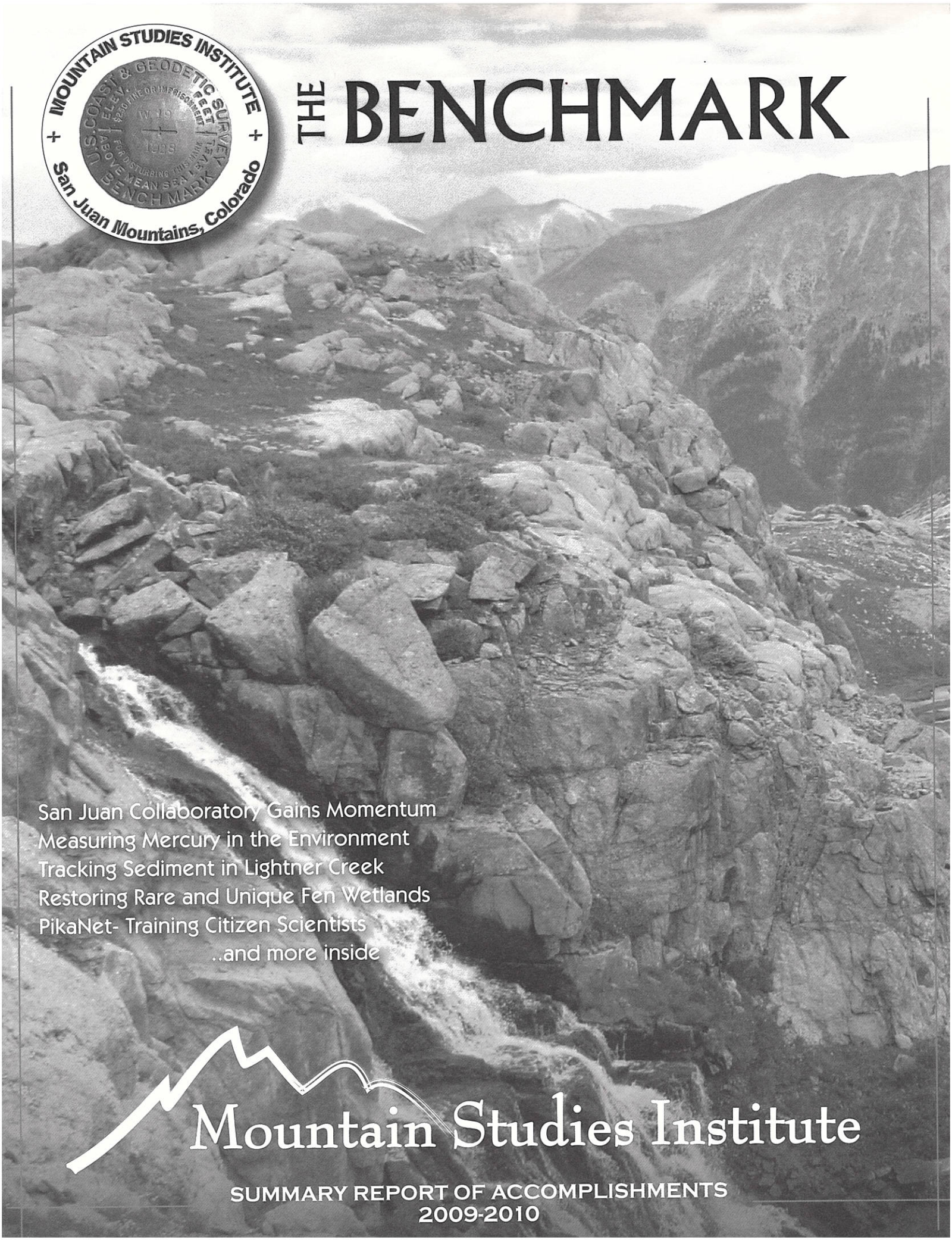

THE BENCHMARK

San Juan Collaboratory Gains Momentum
Measuring Mercury in the Environment
Tracking Sediment in Lightner Creek
Restoring Rare and Unique Fen Wetlands
PikaNet- Training Citizen Scientists
..and more inside

Mountain Studies Institute

SUMMARY REPORT OF ACCOMPLISHMENTS
2009-2010

MISSION

The Mountain Studies Institute (MSI) is a not-for-profit mountain research and education institution in Silverton, Colorado. MSI's mission is to enhance understanding and sustainable use of the San Juan Mountains through research, education, and outreach.

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MSI Board and Staff Appreciation Day at Durango Mountain Resort- January 2010

From the President

Rob Blair

One thing we can be certain of —that is *change*. Since the last Benchmark (2007-2008) we have a new Executive Director, new board members, different facilities and of course ongoing changes in our natural and built environment. We are very grateful for Koren Nydick's leadership and direction, and we are equally grateful for Marcie Bidwell, who started as the new Executive Director. We wish Koren Nydick all the best in her new position as the science coordinator at Sequoia & Kings Canyon National Parks. We welcome our new Board Members and gratefully thank our retiring ones. Continuously, MSI has chosen to embrace change and thrive. We started with a dream of creating a unique model of a research center—a vision of change to develop the potential of the San Juan Mountains as a living laboratory and classroom without walls. With each decision, we reaffirm our commitment to the San Juan Mountain communities to provide research, education, and information about the mountains that they so care for and depend upon for resources. The programs and projects initiated in 2009 and 2010 respond to pressing issues and needs that have been identified by our partners and citizens of this great region.

Now more than ever, the MSI model is necessary. As a geologist and mountaineer I have explored mountain ranges across the globe and know there is no place as special as the San Juan Mountains. The Board of Directors and MSI are looking towards the future: look for exciting science, stewardship, and education initiatives in the years ahead. If these are issues of interest to you, please join MSI as a member and indicate how you would like to be involved. MSI is here for you.

Inside This Issue

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From the Excutive Director (Jan 2008 - Aug 2010)

Koren Nydick

Since starting with MSI in 2004, I have seen MSI mature into a results-focused research and education powerhouse that serves the San Juan Region in ways no other organization can. Since I left MSI, I've seen it continue to thrive with creativity, flexibility, intellectual rigor, and dedication.

MSI is based on a solid need, a "great idea", for rural communities located far from urban-centered universities and government research centers. It fills substantial gaps in scientific knowledge generation, application, and training. Second, MSI has embraced partnerships and provided incredible responsiveness, flexibility, cost-savings, and quality products for our partners. MSI hears a need, evaluates it, and produces top-notch results in less time with less money than agencies can. This publication is full of examples that prove this point. Third, MSI is not just one person, but an idea and a need that attracts many talented individuals. MSI is contagious. I caught the MSI "bug" and it grows stronger as I continue to grasp the uniqueness of MSI's creativity and flexibility in meeting its scientific, education, and economic missions. Catch the MSI bug and become a part of MSI's great idea. Make it your idea too. Help MSI through this rough economic time. Build a field station. Take a stand. Make a donation (I do). But most of all, keep *Science that People Can Use* alive in the San Juans.

From the Excutive Director (Aug 2010 - present)

Marcie Bidwell

As we look at our milestones from the past two years – a period of time with challenges and downturns– we are amazed at what the collaborative efforts of our staff, partners and volunteers have accomplished. At a time when unpredictable changes to our climate and economy are intensifying the challenges of work and life in the mountain world and any non-profit sector, we have completed two of our most active and successful years. To our supporters, partners, Board and staff, we are most grateful.

MSI organizes its work around five key themes: Air Quality, Water Quality, Climate Variability & Change, Ecosystems & Biodiversity, and Communities & Land Use Transitions. For each theme, we have identified challenges, strategies to address those challenges, and where possible, taken actions to engage citizens in addressing them. We conduct and facilitate research, provide educational opportunities and internships, and conduct environmental monitoring. We connect scientists and stakeholders across the San Juan Mountain region to go beyond scientific inquiry to the application of knowledge that makes a difference for the quality of the environment. In addition, citizen science has become an important tool for addressing mountain issues. Towards that end, MSI welcomes your participation in our work to address top environmental issues in our region.

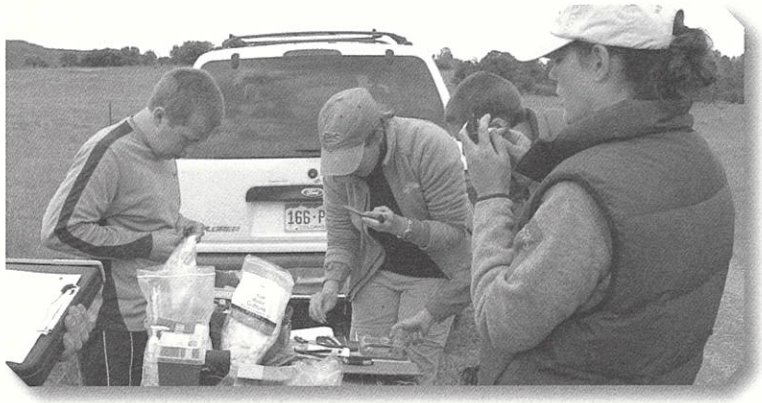
Under the leadership of Koren Nydick, MSI has seen 2009-2010 as its best two year period so far. As MSI's new executive director, I am seeking to build on this momentum. We are confident and excited about working with our partners to make a real difference for the mountains themselves and the people who call them home.

Collaboration as the Foundation

Mountains are great metaphors for collaborations- they are by definition interdisciplinary, multi-faceted, and complex. They are at once fragile environments that weave natural and cultural resources together and also the foundation and framework upon which all life depends. They fuel the human spirit, are a critical source of fresh water and energy, and are a significant repository of biological diversity. Yet, mountains globally are facing natural and human disturbances such as land use alteration, deteriorating air and water quality, and climate change.

To understand and address these challenges, MSI strives to work with an array of partners as vast and complex as the San Juan Mountains which serve as our inspiration. Partnerships are vital and important, as a necessary response to increasingly complex challenges facing land managers, stewardship of large-scale landscape, and inversely shrinking resources. At the heart of a successful partnership are people working together to achieve mutually beneficial goals and shared interests. They succeed because they join the passion, resources and resiliency of committed citizens, organizations, and government agencies through their efforts.

Continuing from our collaborative roots, MSI has flourished as a partnership of many organizations and individuals representing Fort Lewis College, San Juan Public Lands Center, University of Colorado, concerned citizens, and local governments. MSI works with regional stakeholders to identify information needs, while directing and facilitating interdisciplinary research and academic study, applied projects, planning, training, and outreach activities to fill information gaps. Stakeholders include natural resource managers, community planners, elected officials, industry, resource users, citizens, and others in the San Juan region. The 2009-2010 Benchmark illustrates the significance, influence and magnitude of the effect of combining these resources. In particular, two exemplary partnerships are worth illustrating: the San Juan Collaboratory and MSI's partnership with Western Hard Rock Watershed Team, as part of Americorps Volunteers in Service to America (VISTA) program.

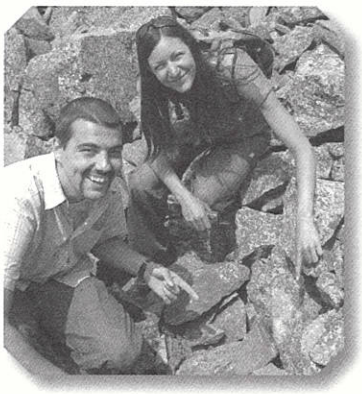


Collaborative pilot study to determine levels of mercury in wetland songbirds, macro invertibrates and stream fish- July 2009

San Juan Collaboratory Gains Momentum

In 2008, the San Juan Collaboratory cemented a formal partnership between MSI, University of Colorado, Fort Lewis College and San Juan Public Lands (San Juan National Forest and Bureau of Land Management) as a unique collaboration to address regional issues through interdisciplinary research, stakeholder engagement, and enhancement of educational opportunities. The focus of the Collaboratory is to develop problem-oriented research efforts to serve the needs of Southwest Colorado's rural communities and establish field-based, hands-on learning opportunities for graduates and undergraduate students through involving them in community-based projects of the Collaboratory. The Collaboratory formed the backbone of many projects that are highlighted on the following pages, including hosting the San Juan Climate Initiative conferences and publications, exploring the hydrogeology of the Fruitland Outcrop, and providing Natural Resources Internship Program.

San Juan Collaboratory: Interns work with MSI staff, Kay Zillich (USFS), and Dr. Rod Chimner (U. Mich) to restore rare fen wetlands at Chattanooga Fen - July 2010



Mike Costello and Katy Rende 2010 VISTA

Building Capacity with Western Hardrock Watershed Team

Starting in 2009, MSI began partnering with the Western Hardrock Watershed Team (WHWT) to involve AmeriCorps volunteers in MSI's programs. WHWT acts as an intermediary to place AmeriCorps VISTA volunteers with environmental non-profits throughout Colorado's mountain communities, especially to work on issues of water quality, mine reclamation, and community revitalization. AmeriCorps VISTA itself is a federal program designed to involve people with national service. AmeriCorps volunteers serve from three months up to a year, and in that time are considered full time volunteers. VISTA volunteers are paid a small living stipend and earn money towards students loans or graduate programs at the completion of their term.

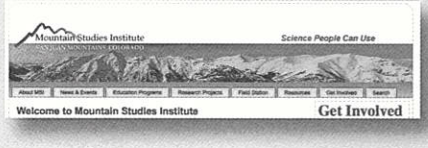
What this means for MSI is that over the last two years, we have been able to engage recent college graduates as full time staff, greatly expanding our capacity. To date, three AmeriCorps volunteers have served at MSI. Katy Rende, our first full year VISTA, completed her year of service in early 2010. Katy worked to grow our membership database, fundraise, and run the field station. MSI has also benefitted from summer AmeriCorps volunteers Mike Costello and Jay Weekly. Mike performed field data collection for the Lightner Creek study, and formalized a partnership between MSI and PikaNet, a region wide initiative to monitor pika. Jay developed outreach tools, wrote news articles, photo-documented our programs, and improved MSI's social media. At the end of 2010, Whitney Gaskill joined the MSI team to develop our education programs and build our outreach capacity through increasing our Moving Mountains series, education programs, and core grant support.

We want to thank our past AmeriCorps volunteers for their contributions and hope to continue to supplement MSI staff with this great partnership!

MSI Introduces New Website!

Thanks to the hard work of MSI staff and Bill Ball at Fort Lewis's Office of Community Services, MSI introduced a newly designed website in 2010. The website address is the same (www.mountainstudies.org), but it now features a more modern look, easier navigation, and information about current events, projects and accomplishments.

Under the 'Research Projects' pages, you can find more information on all of the programs mentioned in this edition of the Benchmark and more. Check out the 'News & Events' section for upcoming talks, conferences, and workshops, as well as links to our monthly e-newsletters. And our home page will always have the most recent information on MSI's activities.



Climate Variability & Change

Mountain environments around the world, including the San Juans, are showing impacts of climate change. Mean annual temperatures in Southwestern Colorado have risen almost 2°C in only three decades and the timing of snowmelt has shifted about two weeks earlier into the spring. MSI studies climate variability and documents trends over time, and also investigates effects of climate on ecosystems and natural resources. MSI's climate outreach provides and interprets scientific information for stakeholders.

Over a three-day period, the conference featured 25 speakers, a panel discussion on Best Practices for Climate Change Impact Assessments, a poster session at the San Juan Historical Society, a workshop exercise on climate adaptation tools, and a number of field trips.

Climate Conference & Workshops

In October of 2010, more than a hundred scientists, land managers, and stakeholders gathered in Silverton to share and discuss current climate science, existing and potential threats to our region, and climate adaptation strategies. The 'Managing for Resiliency' conference was a huge success as MSI engaged people in meaningful dialogue related to climate change. Over a three-day period, the conference featured 25 speakers, a panel discussion on Best Practices for Climate Change Impact Assessments, a poster session at the San Juan County Historical Society, a workshop exercise on climate adaptation tools, and a number of field trips. The conference kicked off with an engaging presentation by Dr. Heidi Steltzer, Fort Lewis College, who presented stories about signs of climate change from arctic to alpine ecosystems.

At the end of the three days, a couple themes were clear: 1) Although climate information is continually evolving and there is a growing body of knowledge with regard to climate impacts to the San Juan Mountain region, we already know enough to act, 2) Many climate adaptation practices for land management are also simply good management practices in general, with benefits to the economy, ecology, and society; and 3) we have opportunities to engage in win-win practices now.

The conference would not have been possible without the efforts of our planning partners from San Juan Public Lands Center, Western Water Assessment, and University of Colorado- Boulder, and the support of our many sponsors and volunteers.

San Juan Climate Initiative

Climate change is happening: southwest Colorado has seen rising temperatures, early snowmelt, and severe wildfires. Efforts at greenhouse gas mitigation are one part of addressing climate change, but finding ways to adapt to climate effects is equally important. Climate adaptation is a newer piece of the climate change discussion, and MSI is working to ensure that our region stays on the forefront of climate change planning. Throughout 2010, MSI participated in Climate Solutions University, a program developed by the Model Forest Policy Program (MFPP) to help communities assess climate change impacts, conduct a risk and vulnerability assessment, and write an adaptation plan. MSI partnered with 4CORE, Climate Change Preparation Group (CCPrep), and Firewise Council of Southwest Colorado for this effort.

Through the vulnerability assessment, MSI found that southwest Colorado is at risk of increased frequency and intensity of wildfires, changes in timing of snowmelt and spring runoff creating late-summer water shortages, and changes in vegetation communities and wildlife habitat. With guidance from the experts at MFPP and input from the community, MSI and partners developed an action plan that focuses on adapting to the increased risk of wildfires. The action plan has MSI working closely with Firewise to spread the word about how climate change will affect wildfire potential. In 2011, MSI will work on implementation of the forest action plan, and expand adaptation efforts to include water issues.

Air Quality

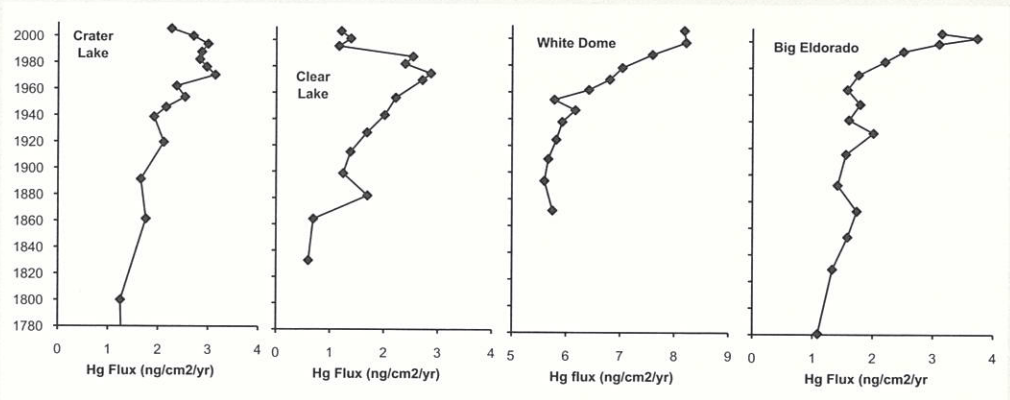
Historically, air quality in the San Juan Mountains has been among the cleanest in the U.S. However, concerns about mercury, ground-level ozone, nitrogen, and other pollutants are growing. Mercury concentrations in precipitation have been alarmingly high and several water bodies have mercury fish consumption advisories. Ozone is approaching the limit for public health, and nitrogen levels in rain and snow are increasing. MSI participates in air quality research by monitoring air, rain, and snow for pollutants. We also study how air pollution affects human health and ecosystem dynamics.

Mercury in the Environment

MSI and Biodiversity Research Institute piloted a study on invertebrates and songbirds which determined current bioaccumulation of mercury to be below toxic levels.

In the Four Corners region of the U.S. Southwest, mercury is a growing concern. This concern stems both from widespread fish advisories -five reservoirs in southwest Colorado are under fish consumption advisories – and from a better understanding about the influence of coal-fired power generation on atmospheric mercury deposition and its subsequent impact on ecosystems. MSI has been on the forefront of this issue for the past four years, with Dr. Nydick establishing multiple studies that sought to investigate both the sources and fate of mercury in the Four Corners area.

In 2010, we completed three studies and initiated two more as collaborations with the National Park Service, US Forest Service, Southwest Hydrologic, Inc., and Biodiversity Research Institute. MSI completed an analysis of mercury in both precipitation and lakes of Southwestern Colorado at Molas Pass in San Juan County. This project also studied mercury concentrations in plankton and sediments from high elevation lakes. Additional work completed in 2010 included analyses of the ecological effects of mercury deposition on songbirds and macroinvertebrates in Mesa Verde National Park. MSI and Southwest Hydrologic Inc. completed a backtrajectory modeling effort that was used to track the sources of mercury found at Mesa Verde. A companion study was initiated to track deposition at Molas Pass.



From Mercury in Lakes and Precipitation of Southwestern Colorado report- showing Mercury (Hg) flux over time in sediment cores from four alpine lakes with up to 1.5 - 6 times pre-historic rate of deposition (post 1870- 1990).

LINK For more information, go to www.mountainstudies.org Research tab for Air Quality.

In 2011, MSI is expanding and initiating a number of mercury related projects. The first, is a continuation of the backtrajectory modeling effort done in 2009 by Southwest Hydrologic. We will now be able to use a larger dataset to gain a better understanding of the sources of mercury in the San Juan Mountains and the conditions that carry it here. Another project that is getting off the ground in 2011 is a study to examine the fate and transport of mercury in forest soils following forest fires. This project is a collaborative effort, funded by the National Science Foundation, and includes collaborators Dr. Koren Nydick (National Park Service), Dr. Joe Ryan (University of Colorado-Boulder), Dr. George Aiken (USGS), Dr. Kathryn Nagy (University of Illinois, Chicago), as well as MSI staff Chris Peltz and Marcie Bidwell and many other interns, undergraduate and graduate students. This project is a multi-year effort to determine the chemical and physical effects of forest fire on the flux of mercury through the environment.

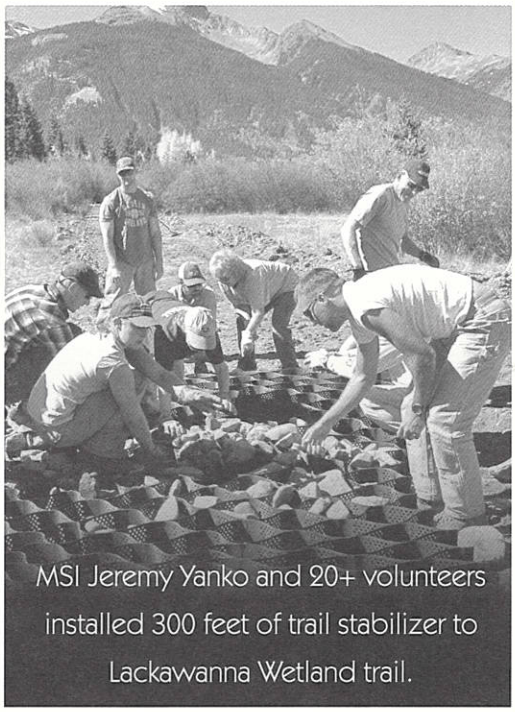
Communities & Land Use Transitions

San Juan Mountain communities are in various stages of transition from mining, agriculture, and forestry industries to those based upon tourism, recreation, oil and gas extraction, and amenity-led migration. The region will experience tremendous change over the next 50 years as human population continues to grow and as demand for natural resources increases. Community and land managers will be faced with increasingly difficult planning and development decisions. MSI studies past, current, and future land use change, and subsequent effects on communities, natural resources, and ecosystems. MSI also provides expertise to community projects that combine ecological, cultural, and economic sustainability goals.

Animas River Corridor Revitalization Project

Over the last two years, the trails initiative, known as the Animas River Corridor Revitalization Project (ARCRP), has steadily moved forward. Accomplishments include designing the trail alignment, developing an agreement between the Town of Silverton and Durango Silverton Narrow Gauge Railroad, and securing liability insurance. In 2009, MSI worked with Smith Engineering to develop engineered drawings and with Army Corp of Engineers to permit the installation of a raised trail through the edge of the Lackawanna wetland reclamation area. MSI led the project to approach the Public Utilities Commission (PUC) to approve trail crossing for the railroad tracks between the Silverton Depot and Visitors Center. As the PUC application process is quite extensive to navigate, the project team prioritized segments to move forward with sections that did not require PUC approval until a solution can be found. ARCRP partners continue to seek an effective solution.

In the summer of 2010 as part of the National Public Lands Days, the initiative installed the raised trail through the Lackawanna wetland to reduce impacts from unconsolidated use while maintaining water flow. Over two days, 20+ volunteers, machinery from Maisel Construction, gravel from San Juan County, and a lot of positive attitudes installed 300 feet of trail. This piece proved to be a momentum booster after facing so many hurdles in prior efforts. MSI's work on the ARCRP continues with new ideas and goals for 2011.



MSI Jeremy Yanko and 20+ volunteers installed 300 feet of trail stabilizer to Lackawanna Wetland trail.

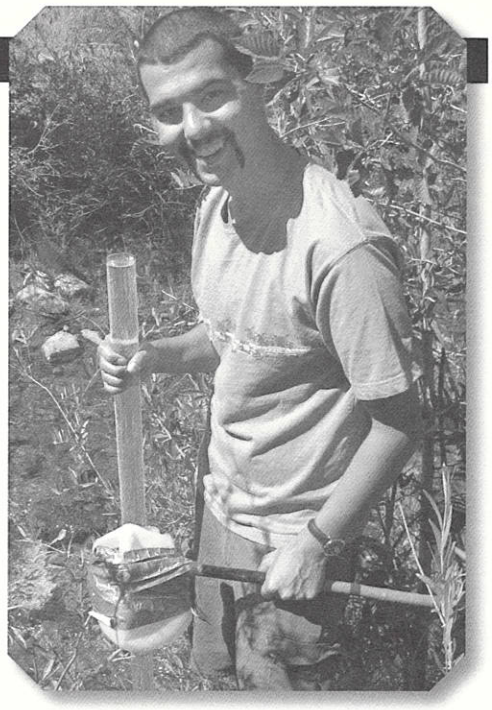
Biochar as a Tool for Abandoned Mine Reclamation

Some of the most significant and enduring problems of the historic mining in the San Juan Mountains are the soil and water quality degradation associated with abandoned mine tailings, waste rock piles and draining adits. These sites contribute highly mineralized soil and acidic water to local watercourses through the erosion of contaminated soils; primarily due to lack of vegetative cover. The redistribution of mineralized soils through fluvial and aeolian processes has had significant, deleterious effects on water quality and the biota of Animas River headwaters. A major impediment to reducing the amount of pollution coming from mining works is the difficulty of re-establishing vegetation and active soil processes on sites that are devoid of vegetation and have conditions that are generally hostile to plant colonization. The challenges of re-growing vegetation at these sites are multiple, and include: acidic soils, harsh climatic conditions, and adverse physical conditions associated with soil compaction and low water retention.

To address some of these challenges, MSI, in conjunction with the US Forest Service and the Bureau of Land Management Abandoned Mine Lands (BLM-AML) program have initiated a multi-year investigation on the effect of biochar on increasing vegetation cover and growth, reducing metals leaching from mine tailings, and increasing the rate of soil forming on these highly toxic sites. As part of this effort in 2009 MSI intern Amanda Goldstein implemented the initial test trials with assistance from Lisa Richardson and Tom Johnson (both of BLM) and Koren Nydick. Based on the positive results from this work, in 2010 MSI with its Forest Service and BLM partners expanded the project to include five new sites, a greenhouse/container trial, soil leachate chemistry analysis, and a phytotoxicity test. This work was completed by Chris Peltz (MSI) with able assistance from MSI Interns Morgan Ruth Hill (University of Colorado), and Chad Quinn (Fort Lewis College). The results from this work were presented at the 2010 Geological Society of America meeting and the Rocky Mountain Biochar Initiative Symposium. This project will continue in 2011 with support from the BLM-AML coordinator Kay Zillich and many other collaborators from Fort Lewis College, USFS Rocky Mountain Research Station, USGS and MSI Interns.

Water Quality

Mountains are the "water towers of the world." In the Western U.S., 50 to 80% of the water supply originates in seasonal mountain snowpack. A growing challenge is maintaining aquatic ecosystem health while meeting human demand for water resources and flood hazard protection. MSI studies both the natural variability and human-caused change in water supply, water quality, and aquatic ecosystem health in the San Juan Mountains.

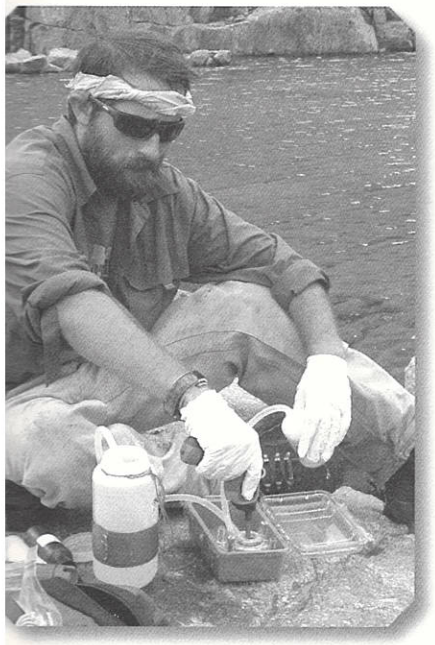


MSI VISTA volunteer collects water samples for Lightner Creek monitoring- July 2010

Lightner Creek Sediment Initiative

An outstanding example of stakeholder-driven science is the Lightner Creek Sediment Initiative. This project emerged from the concern of local citizens who noticed that Lightner Creek was depositing large amounts of sediment into the Animas River, particularly during summer monsoon rain events. Excessive sedimentation in waterways can degrade water quality and negatively influence fish habitat, which is of significant concern since the area affected is part of the Gold Medal Fishing stretch of the Animas River. A number of groups, including MSI, Trout Unlimited, San Juan Citizen's Alliance, Basin Hydrology, City of Durango and interested landowners, came together to examine the causes of the sediment inputs and look for solutions.

Phase 1 of the initiative, Watershed Assessment, was completed in March 2010 by Basin Hydrology. MSI took the lead on Phase 2, Sediment Monitoring, and conducted water sampling and analysis from March 2010 to November 2010. Sampling occurred at six sites along Lightner Creek and one site on the Animas River, and water quality metrics such as dissolved oxygen, temperature, specific conductivity, and total suspended sediment were tested. The results of this effort showed that a large portion of the sediment delivered to the Animas has its origin in Perins Canyon. The sediment washes down the canyon into Lightner Creek during intense rainstorms, and then is deposited in the Animas when Lightner Creek has high flows. MSI has published a final report on the Sediment Monitoring phase which makes a number of recommendations for best management practices that may reduce the excess sediment reaching Lightner Creek. MSI plans to continue monitoring sediment supply and transport.



Researcher Chris Peltz processes water samples at Upper Grizzly Lake

Alpine Lakes Water Sampling

Alpine environments are by their very nature often remote and as a consequence of that remoteness typically less impacted by humans. This provides a unique opportunity for researchers to study how global air patterns move different elements through the atmosphere by sampling water from alpine environments — the higher the better. However, the challenges of obtaining water samples from alpine environments are many, and the difficult logistics make long-term sample records few in number. Despite these challenges the USGS has been monitoring alpine lakes in Colorado since the mid-1980 for a range of minerals and nutrients as part of the USGS Acid Rain Program and U.S. EPA's Long-Term Monitoring Network. The lakes in the San Juan's that are part of this network are the Big and Little Eldorado, White Dome, Lower and Upper Sunlight, and Upper Grizzly Lakes, all of which are located in the Weminuche Wilderness, which is a Class I wilderness area.

In 2009 MSI was contacted by Alisa Mast (USGS) to potentially take over the field sampling effort, and after some training MSI began a five-year contract to collect the water samples in the San Juan's. This project involves three trips every summer into the wilderness area to collect samples and observe any changes in the character of the lakes and surrounding alpine environments. This project allows for a great synergy of US Federal researchers and MSI to conduct a challenging, yet highly rewarding field campaign to collect this unique and important information.

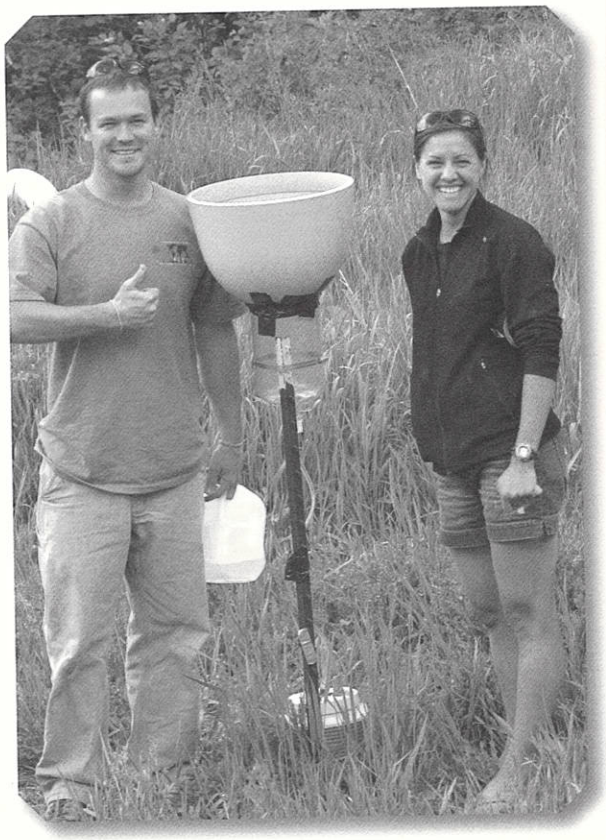
Water Quality (cont.)

Hydrogeology of the Fruitland Outcrop and Impacts Associated with Coal Bed Methane Extraction

MSI intern Jordan Van Sickle collects water sample from Florida River Drainage, 2009

There remains considerable uncertainty about how coal bed methane (CBM) production from the Fruitland Formation may affect the quantity and quality of surface waters, springs, wetlands, and groundwater systems near the northern Fruitland Outcrop in southwest Colorado. The Late Cretaceous Fruitland Formation of the San Juan Basin is presently the second largest gas-producing CBM basin in the United States, with total reserves estimated at 1.4×10^9 m^3. It is also one of the most extensively studied CBM basins the world, having been the subject of many chemical and isotopic investigations, geophysical logging studies, and stratigraphic analyses. However, there remains considerable controversy over its hydrology: specifically, over the age of Fruitland Formation waters, the extent to which the Fruitland Formation aquifer undergoes active hydrologic through-flow, as well as if, and how, CBM production will affect surface—groundwater interactions at the Outcrop. To support this understanding the USFS contracted with the Mountain Studies Institute, Fort Lewis College, and University of Colorado to conduct chemical and isotopic analyses of various sources of water both in the Fruitland Outcrop and a varying distances away from the Outcrop.

This project required a multi-element and multi-agency approach and included Dr. Mark Williams and Adrianne Kroepsch of University of Colorado, Dr. Gary Gianniny of Fort Lewis College, and MSI staff Dr. Koren Nydick, Jordan VanSickle, and Chris Peltz, in conjunction with support from the USFS/BLM San Juan Public Land Center's Kelly Palmer, Matt Janowiak, and Ivan Geroy. As part of this project, the field team collected water samples from 60+ sites north and south of where the Fruitland formation daylights - roughly parallel to Colorado Highway 160 between Durango and Pagosa Springs. Water samples were collected from both surface waters (precipitation, streams, springs and irrigation ditches), and groundwater (coal bed methane wells, domestic wells and piezometers). Following collection, these samples were analyzed for all major anions and cations as well as stable isotopes of hydrogen and oxygen and radio-isotope tritium. The tritium is used estimate the last time when the waters were in the atmosphere. Future work for 2011 and beyond will focus on tools the USFS can use to effectively protect surface and groundwater resources while facilitating the multiple-uses, such as minerals and water supplies that U.S. forests provide.



MSI interns Jordan Van Sickle and Adrienne Kroepsch gather water samples, 2010

Ecosystems and Biodiversity

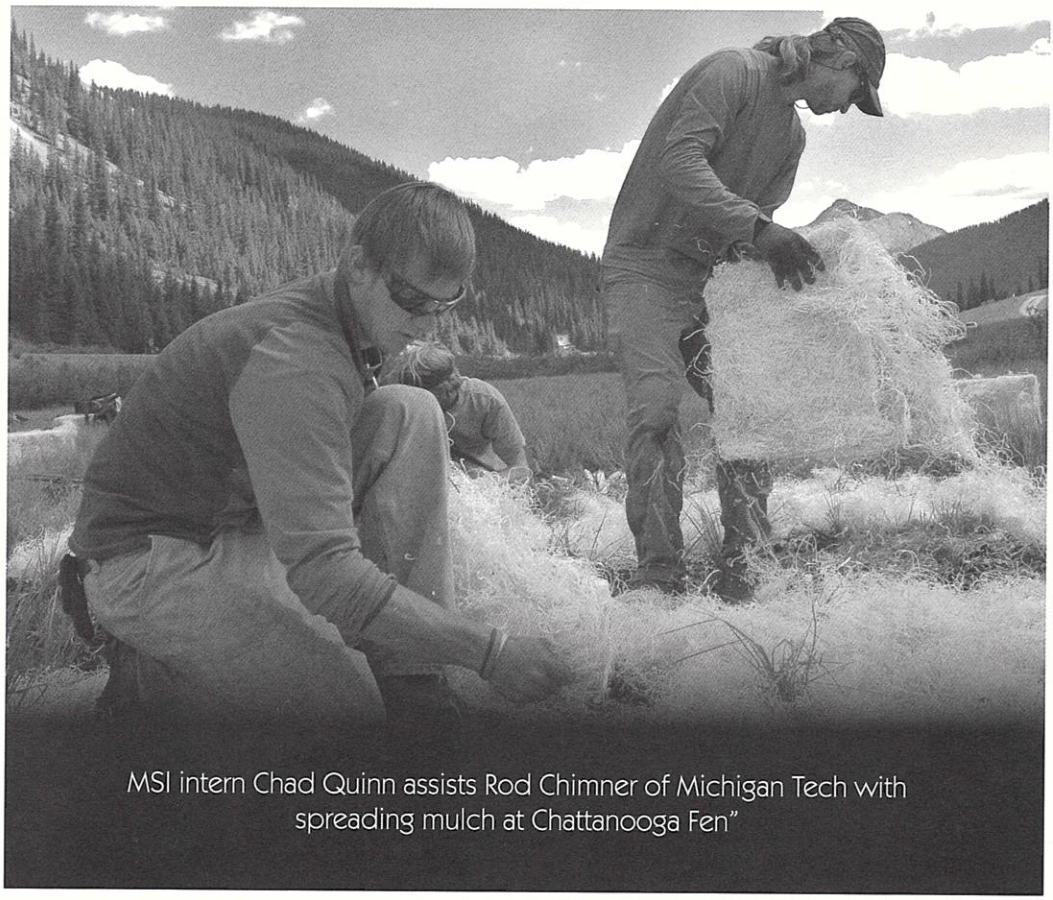
Mountains are elaborate environments characterized by complex topography, multiple ecological zones, and biological diversity. The complexity of the San Juan Mountains – from semi-arid rangeland to the alpine zone – results in a diversity of ecosystem types in a relatively small geographical area. From the smallest microbes to the tallest trees, these diverse ecological systems provide people with products (timber, medicinal plants and recreational opportunities) and ecological services (filtering pollutants, stabilizing soils and retaining nutrients). MSI studies ecosystem processes and biodiversity to understand the factors that regulate them. We identify linkages between ecosystems and delivery of ecological services to society; and develop tools that allow stakeholders to incorporate information about ecosystems and their societal value into planning and decision-making.

Restoration of Rare and Unique Alpine Fen Wetlands

Fens are wetlands that accumulate peat over thousands of years. Fens require perennially saturated soils produced by nearly constant groundwater inflow to accumulate the peat. In the San Juan Mountains, fens are 8,000- 10,000 years old, and these unique systems are highly sensitive to changes in their water structure and hydrology. Past mining practices altered the drainage patterns through ditching and dredging these areas, which lowers the water tables and accelerates erosion.

Since 2003, MSI has been working to support research, conservation, and restoration of fen wetlands. These unique ecosystems are rare throughout the western U.S., but surprisingly abundant in the San Juan Mountains, where even very rare 'iron fens' can be found. Fens provide multiple ecological services, including providing critical habitat for plant and animal species that persist only in fens, filtering large volumes of water, and sequestering vast amounts of carbon as peat. Dr. David Cooper (CSU) and Dr. Rod Chimner (Michigan Tech) have been researching the San Juan fens for years, and over the past two years have focused their efforts on revegetation of a number of fens. Small-scale test plots were used first to find the best method. At Chattanooga Fen near Silverton in 2009, 100 feet of ditches were filled through dams and infilling of soil and excelsior (aspen) bales to restore the hydrologic conditions. Revegetation with sedge plugs of over 400 square feet of bare ground was also accomplished, through the efforts of MSI staff and interns, Dr. Chimner, and Kay Zillich (USFS). Hydrologic monitoring in 2010 showed an increase in the water table in the area below the restoration activities, and water elevations in Chattanooga Fen are now more closely matching the reference conditions.

In addition to restoration work, MSI has continued fen education efforts through conducting workshops, demonstration projects, trainings in Silverton and Telluride, and San Juan Fen Partnership activities. In 2009, MSI hosted San Juan Fen Partnership meeting and field tour in Telluride. Rod Chimner, Koren Nydick and Marcie Bidwell hosted the 2010 Fen Restoration Workshop which featured an introduction to restoration techniques. Dr. Cooper and Marcie Bidwell hosted the 2010 Prospect Basin Tour and San Juan Fen Partnership meeting to discuss new and continuing efforts to understand long-term changes in fens.



MSI intern Chad Quinn assists Rod Chimner of Michigan Tech with spreading mulch at Chattanooga Fen"

Ecosystems and Biodiversity (cont.)

PikaNet

photo by Alfred Viola, Northeastern University

The American Pika (Ochotona princeps), though relatively inconspicuous in its own right, has received increased attention in the past years as an indicator species of climate change. Pika are closely related to hares and rabbits, but in appearance are more similar to mice. With small round ears, and a distinctively absent tail the Pika survives in high alpine ecosystems (usually not found below 10,000 feet in Colorado) by burrowing amongst talus and rocky slopes and hoarding nests of plant material. The American pika is uniquely dependent on its high altitude abode because of its inability to regulate its body temperature. While humans sweat, dogs pant, and pigs wallow in the mud; the pika never adapted a mechanism for cooling their body temperature. Now, as temperatures increase due to global climate change, they are forced to seek higher and higher elevations for the cool temperatures they need. Eventually they are predicted to be forced in to genetic isolation, existing only at the very tops of mountains. In the great basin area alone, seven out of twenty five study populations have gone extinct in the latter half of the 20th Century.

While this doesn't sound good for the pika, researchers and citizen scientists across the West have mobilized on behalf of our small furry friend. While similar initiatives exist elsewhere, PikaNet was founded in 2009 to consolidate efforts in Colorado to track this creature. PikaNet is an extensive partnership between researchers at the University of Colorado Boulder, technologists from Colorado State's Natural Resource Ecology Laboratory, educators from the Denver Zoo, Rocky Mountain Wild, and Mountain Studies Institute, and agency partners at the Colorado Department of Parks and Wildlife.

All partners contribute to the development of curriculum and protocols that allow citizens to step in to the researcher role and collect critical information about the pika. Trainings are held regionally, facilitated in the Front Range by the Front Range Pika Project, a partnership of the Denver Zoo and Rocky Mountain Wild, and here in the San Juans by MSI. In classroom and field trainings, citizen scientists learn to identify pika, through sight, sound, and their distinctive hay piles.

Once volunteers have gone through the trainings, they are able to record the locations of pika sightings during personal recreational hikes and then report to an online database at www.citsci.org (managed by the CSU Natural Resource Ecology Laboratory) that can be accessed by scientists and land managers alike. Eventually these data points are converted in to comprehensive GIS maps. Specifically, the DPW will use this data as they create management plans for this important indicator species.

In the summer of 2010, MSI AmeriCorps volunteer Mike Costello worked to develop MSI's PikaNET program. During his service, Mike, working with former Education and Operations Coordinator Anne Izard to offer the first Pika monitoring trainings for the greater San Juan Mountain area including Durango, Silverton, Lake City, and Telluride.

Over the next several years, it is hoped that PikaNET can develop a data set that begins to answer the following important questions:

1. What is the current pattern of pika occupancy in the Southern Rockies?
2. What habitat variables determine current distribution?
3. Is pika habitat changing?
4. Do the changes in pika occupancy patterns and pika habitat suggest that pikas are declining in the region in response to global climate change?
5. How can pika populations in the region be expected to respond to global climate change?

Volunteering for PikaNet is not only a great way to see wildlife on personal trips, but provides a unique opportunity for citizens to engage in climate science in a productive and meaningful way. While climate change debates in the media fuel increasing fear and confusion, PikaNet and MSI are providing people with a way to step up and take action.

Please see the MSI website for available pika monitoring trainings or e-mail current OSM/VISTA Whitney Gaskill at msivista@gmail.com for more information.

Education

MSI continued to make education a priority in 2009-2010 through the Natural Resources Internship Program, Moving Mountains Education Series, Mini-grant funding for undergraduates, and a new Citizen Science program. Education is closely tied to our program themes and research efforts. MSI uses knowledge gained from research to provide learning opportunities to professionals, scientists, graduate and undergraduate students, teachers, and the general citizenry. A place-based, experiential education philosophy means that education at MSI is a two-way street: we educate people through involving them in inquiry-based projects and research initiatives, and they contribute to research through being involved in projects or monitoring efforts. When a community member goes out to survey pika or attend a Moving Mountains lecture, they learn something about our region. When a student at FLC completes a mini-grant project, they are examining a problem relevant to our community and learning the power of inquiry and information. Informed, educated citizens are more likely to take action on a particular issue facing the community, and MSI works to provide accurate and relevant information.

Natural Resource Internships

2009 interns (full list on page 14)

The San Juan Collaboratory Natural Resources Internship Program saw two more successful years in 2009 and 2010. Over this two year period, 19 interns participated in the program. The interns worked on projects ranging from the ecological effects of air pollution to old growth forestry surveys. Some interns work directly with MSI, while others are mentored by agencies, including the USFS and BLM, or local organizations like 4CORE. The goals of this program are to provide students and recent graduates from Colorado and beyond an introduction to work in the natural resources field. Interns gain valuable experience working outdoors on relevant research projects, and get the opportunity to make contacts with scientists, stakeholders, and land managers. Plus, the interns have a great time working in the beautiful settings that the San Juan Mountains offer! While some interns go back to school after the summer to finish up their undergraduate degrees, others have been offered further work through the internship or continue on to graduate school.

2010 interns show off their finery and humor after completing their mid-term restoration project

MSI has gotten positive feedback from both interns and mentors. Ken Baker (2010 intern), who worked with the San Juan Public Lands Center as a Hydrology Technician, said "this program was such a great way to gain so many beneficial workplace contacts, as well as gain experience in my academic field.... I learned so much about field science and how to conduct proper data collection all the while becoming accustomed to many new tools and devices." Teresa Shishim, mentor of the 4CORE intern, said "The MSI intern we hired in the summer of 2010 proved to be such a valuable asset to our project that we hired her full time after the internship was complete. She brought a foundation of skills to our Climate and Energy Action Plan process that complimented the effort and we were able to build on that foundation to bring her to the level of a valuable employee."

Education (cont.)

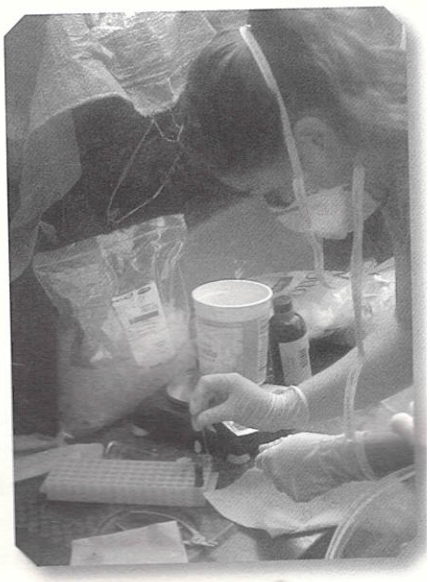
List of 2009 and 2010 Interns

2009		
Beth Adams	University of Colorado at Boulder	Ecological Effects of Air Pollution
Mathew Attiyeh	University of Colorado at Boulder	Collection of Baseline Hydrologic Data
Michael Freer	Fort Lewis College	Ecological Effects of Air Pollution
Amanda Goldstein	Oberlin College	Abandoned Mine Lands Reclamation
Ryan Kosmatka	University of Colorado at Boulder	Forestry and Old Growth
Chelsea Little	University of Pittsburgh	Abandoned Mine Lands Reclamation
Phillip Neumann	University of Colorado at Boulder	Field Hydrology and Air Quality
Elizabeth Ogata	Wesleyan College	Fen Inventory
Charlotte Rand	University of Colorado at Boulder	Fen Restoration
Elysia Retzlaff	University of Utah	Field Hydrology and Air Quality
Roger Smithhart	University of Mississippi	Forestry and Old Growth
2010		
Ken Baker	Fort Lewis College	Field Hydrology and Air Quality
Bryan Barnett	Fort Lewis College	Riparian Forestry
Morgan Hill	University of Colorado at Boulder	Abandoned Mine Lands/Biochar
Chad Quinn	Fort Lewis College	Abandoned Mine Lands/Biochar
Dennis Marken	Texas A & M	Old Growth Forestry
David Mower	Northland College	Old Growth Forestry
Amanda Saunders	University of North Carolina at Chapel Hill	4CORE: Community Energy Efficiency
Carolyn Livensperger	State University of New York at Plattsburgh	Environmental Science

Mini-Grant Program

MSI supports undergraduate student research through the mini-grant program. Students are selected for their original ideas for independent research projects. The program seeks to build inquiry-based skills, foster creative research ideas and approaches, and develop a core of young scientists interested in mountain research. Between 2009 and 2010, a total of $10,190 was contributed to student research, supporting thirteen students.

David Todaro added to the regional understanding of the geologic stratigraphic model of the Hermosa Cliff formation near Rico by examining fossils. Jessica Lathrop investigated potential changes in silver iodide concentrations in terrestrial ecosystems as a potential result of a weather modification procedure known as cloud seeding. Jordan Van Sickle analyzed a succession of evaporate rock layers of gypsum and salt associated with the Hermosa Group Formation in Paradox Basin, Colorado. Neil Bourjaily characterized differences in immune responses of deer mice infected with Sin Nombre virus (SNV) in different reproductive states. Tarah Nelson surveyed deer mice in aspen forests to determine how SNV differs across forests affected by Sudden Aspen Decline syndrome.



Tarah Nelson measures Sin Nombre Virus in deer mice inhabiting aspen forests with Sudden Aspen Decline syndrome.

2009 Recipients

David Todaro
Jessica Lathrop
Jordan Vansickle
Neil Bourjaily
Tarah Nelso

2010 Recipients

Brook Cumbie
Cherin Chapman & Tori Queen
Colleen Obrien
Melissa Boley
Nellie McLean
Ruby Siegl
Tomas Sash
Trevor Ycas

Education (cont.)

Take Your Class to the Mountains

MSI provides opportunities for Fort Lewis College classes and organizations to take field trips in the San Juan Mountain region. The goals of this program are to enhance field-based learning opportunities that immerse students in the "natural laboratory" outside our door – thereby providing connections for Fort Lewis College's curriculum to "real places" and/or "real people" that work on mountain issues. Recipients may use the award towards transportation, food, lodging, guest speakers, and/or supplies. In 2009, MSI hosted two field courses and two department retreats: (1) courses were Southwest History Since 1968 and Field Ecology led by Dr. Pete McCormick and Dr. Julie Korb respectively; and (2) History Department retreat and KDUR Board Retreat, lead by Dr. Neil McHugh and Bryant Liggett respectively. In 2010, two student courses and two conferences/retreats joined MSI at our field station: (1) Drs. Julie Korb and Erin Lehmur's Senior Seminar and Dr. Mary Ann Goff's Teaching Science to Preschool to 6th Graders; and (2) seminars included History Department retreat lead by Dr. Ellen Paul and Pecos Conference led by Dr. Charles Riggs, Anthropology Department. This program benefitted a total of 47 and 52 Fort Lewis participants, including instructors, professors and students.

Moving Mountains Outreach Series Connects People to Mountain Issues

Ozone injury participants examine injury to plants near Falls Creek, Colorado- July 2009

Each year, MSI sponsors seminars, workshops and field trips by researchers and practitioners on a variety of topics ranging from climate change to historic preservation. MSI believes in the Moving Mountain Series as an important step from moving science and information out of books and formal reports and into an accessible format that makes the information available and useable for citizens across the region. Seminars and field trips are designed to be on the low-tech side and are free to the public; they offer an opportunity to learn about current and recent research initiatives from scientists as information is developing from their efforts. MSI also sponsors workshops, which target professional land and water managers, local government officials, and scientists with detailed, cutting-edge information and state of the art practices. These workshops are also open to the public. In 2009 and 2010, MSI offered 16 and 12 events respectively. Starting 2009 off with a great theme, Dr. Christy McCain spoke to Fort Lewis College students on "Mountains as Natural Experiments in Biodiversity." Peggy Lyon led a wildflower walk at Red Mountain Pass, and Dr. Erin Lehmer presented on the "Dynamics of Sin Nombre Virus" and the implications for human health. Liesl Peterson initiated the PikaNet project with a presentation on the patterns of Rocky Mountain pika and their persistence in a changing climate. Dr. Borrok led a tour of "Acid Mine Drainage in the San Juans." Dr. Heidi Stelzer presented her research "How Early Snowmelt Due To Desert Dust Affects Alpine Plant Communities" regarding her research at Red Mountain Pass. MSI hosted a series of events on air quality including the San Juan Air Quality Forum and a workshop "Air Quality and Human Health in the Four Corners." Other key events focused on the affects of drought, graduate research opportunities focused on the cryosphere, and identifying sphagnum moss.

In 2010, MSI kicked off the year with an inspirational presentation by Jon Kedrowski, "Climbing High: Exploring the Physical and Human Geography of the World's Highest Mountains." Workshops and seminars explored techniques and methods for Fen Restoration and Water Quality Monitoring hosted by Drs. Chimner and Nydick and Dr. Borrok, respectively. MSI hosted the second annual San Juan Basin Air Quality Forum, hosted a technical training for San Juan Public Lands Center on Climate Adaptation Planning, and led a climate adaptation planning workshop for the La Plata County Climate Adaptation Plan as part of the Climate and Energy Action Plan. MSI Trail Coordinator Jeremy Yanko and Hugh Osborne hosted National Public Lands Day trail building workshop at Lackawanna wetland. Finally, MSI closed the year with "Managing for Resiliency: Climate Adaptation and Change" conference for 120 people.

Contributors and Supporters

We are deeply grateful to these donors and supporters for their commitment to MSI and our mission. Through their generosity, our work continues and grows to understand and enhance the qualities of the San Juan Mountains that we all value. The following reflects grants and program support from January 2009 to December 2010. We have made every effort to ensure that this list is complete and accurate. Please contact us with corrections by calling (970) 387-5161 or emailing info@mountainstudies.org.

Grants, Contracts & Contributions

CSU Colorado Forest Restoration Initiative - $11,000
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Southern Ute Tribe - $500
Southwest Water Conservation Conservation District - $4,325
State Historic Fund - $141,437
Town of Silverton - $7,300
Trout Unlimited - $1,000
United States Geological Survey - $8,200
USDA Forest Service Rocky Mountain Research Station - $222,985

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MSI wishes to acknowledge the individuals and institutions whose cash and in-kind donations sustain our work.

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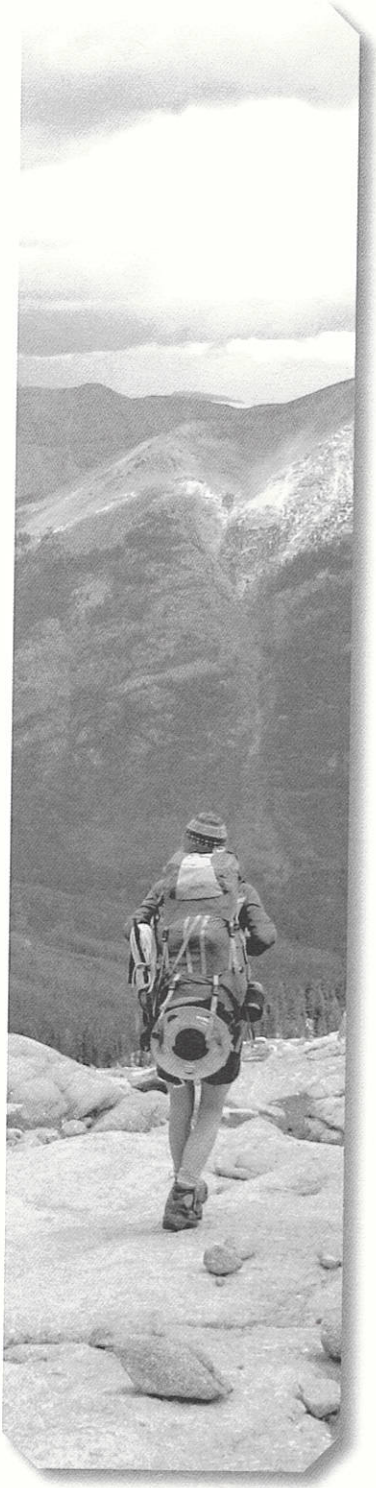

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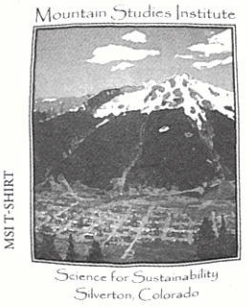

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