MONTANA NSF EPSCoR

September 2013

MONTANA NSF EPSCOR **APPOINTS NEW PROJECT DIRECTOR**

Montana NSF EPSCoR is pleased to announce the appointment of Dr. Ragan Callaway as the new project director for the EPSCoR Track I award. Dr. Callaway is a professor in the Division of Biological Sciences at the University of Montana. Montana EPSCoR is administered through the Office of the Commissioner of Higher Education and serves every university, college and research institution in Montana. Montana was one of the five states that joined NSF EPSCoR when the program began in 1980. Montana is now one of 28 participating jurisdictions. Dr. Callaway is a recognized expert in community ecology and has been at the University of Montana since 1993. He succeeds Dr. Mark Young who was the Montana NSF EPSCoR project director since 2001.

The Track I EPSCoR (Experimental Program to Stimulate Competitive Research) award is a 5-year $24M statewide infrastructure grant intended to improve the research competitiveness in the state. EPSCoR is funded by the National Science Foundation (NSF) and other federal agencies to help scientists and engineers in rural states become nationally competitive and to assist states in building their research infrastructure. NSF EPSCoR also builds state and federal partnerships that use science and engineering to create new jobs and improve rural economies. The focus of the current award is understanding the effects of climate change on sustaining healthy ecosystems and economic growth. The Institute on Ecosystems (IoE) is the mechanism through which the current Track 1 EPSCoR activities are implemented, including new faculty hires, undergraduate and graduate student support, workforce development, and public outreach.

Project Director Callaway brings an active international group of scientists into the MT EPSCoR program through his studies of alpine biodiversity. Recently this group—which includes University of Montana-Western professor Wendy Ridenour and scientists from 14 countries—collected data in mountain ranges around the world to assess the relative importance of biotic interactions and climate in determining plant diversity in alpine ecosystems. They found that stress-tolerant species act as a "safety net" that sustains biodiversity under very harsh conditions.

A new discovery of this work was that the shelter provided by stress-tolerant plants for other species affected biodiversity almost as much as global variation in climate. These stress-tolerant species enhanced biodiversity more in ecosystems with an inherently impoverished local species pool, and therefore buffered the negative effects of severe climate and low productivity. Their results also show that the effects of climate and species interactions should be integrated when predicting future effects of climate change on biodiversity.

ABOVE: Ragan Callaway (right) and Lohen Cavieres from Chile's Concepción University at a field site in the Dolomites, northeastern Italy.

INSIDE

NEW **FACULTY**

The Institute on Ecosystems welcomes the following new EPSCoR-supported faculty hires. Profiles of Drs. Hu, Ballantyne and Mullan are in this issue. Others will be featured in future newsletters.

Ashley Ballantyne (UM) Ecosystem and Conservation Science

Craig Carr (MSU) Animal and Range Sciences

Jean Dixon (MSU) Earth Sciences - Geology

Michelle Flenniken (MSU) Plant Sciences and Plant Pathology

Julia Haggerty (MSU) Earth Sciences - Geography

Jia Hu (MSU) Ecology

Jamie McEvoy (MSU) Earth Sciences - Geography

Jonah Morsette (Little Big Horn College) Mathematics

Katrina Mullan (UM) Economics

Rob Payn (MSU) Land Resources and Environmental Sciences

Brett Runnion (Stone Child College) Mathematics

Carl Yeoman (MSU) Animal and Range Sciences

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Some of the IoE new faculty hires at MSU, (L to R) Jia Hu, Jean Dixon, Rob Payn, IoE Co-director Cathy Whitlock, Jamie McEvoy and Julia Haggerty.

KATRINA MULLAN, ECONOMICS, UM

Katrina Mullan is an assistant professor in the Department of Economics at the University of Montana. Mullan studies the impacts of forest conservation policies on the livelihoods of rural households, with a current focus on Brazil and China. She uses panel surveys and remote sensing data to conduct quantitative empirical analyses of the decisions made by households about land-use, employment and migration; and the outcomes of these decisions.

Mullan joined the University of Montana in 2012, following post-doc positions at UC-Berkeley and North Carolina State University. Originally from the UK, she has a PhD in Environment and Development Economics from Cambridge University, and previously advised on environmental policy for the UK government and the European Environment Agency. She is working with researchers in the IoE on the potential implications of policies as related to rural communities. In addition to her research, Mullan teaches courses in environmental economics, econometrics and microeconomics.

ASHLEY BALLANTYNE, FORESTRY, UM

Ashley Ballantyne was recently hired as a bioclimatologist in the College of Forestry at the University of Montana. He studies the interactions between the biosphere and atmosphere and how changes in climate affect these interactions over a range of time scales. Currently, Ballantyne is researching the global carbon cycle, the amplification of Arctic temperatures, and changes in dust emissions across the Western US. As an assistant state climatologist, he meets with stakeholders, scientists, resource managers, and politicians to learn how climate information can help their decision-making.

Ballantyne is an assistant professor in the College of Forestry and Conservation at UM. Most recently he was a research scientist at University of Colorado – Boulder. He received his bachelor's degree from UC-Davis and graduate degrees from the University of Washington and Duke University. Since coming to UM in August 2012, Ballantyne has been busy with teaching, research, and outreach. He introduced a new course on ecosystem climatology to the ecology curriculum at UM and led a graduate student seminar entitled "Global Drought and Climate Change." His research program is growing: He has been busy submitting proposals, publishing papers, and mentoring the two graduate students in his group.

Ballantyne has started collaborating with Cathy Whitlock, IoE co-director, to look at the role of fire in the amplification of Arctic surface temperatures. In addition to his university work, he has been involved in re-establishing the Montana State Climate Office.

JIA HU, ECOLOGY, MSU

Jia Hu has been at Montana State University for just a few months, but is already immersed in Montana ecosystem science: writing grants, engaging in outreach, conducting research with MSU and UM colleagues, and developing a new climate science course.

An assistant professor in the Ecology Department, Hu came to MSU in June 2013 after spending two years at the University of Sydney on an Australian Research Council Early Career Fellowship. Hu earned her PhD in Ecology and Evolutionary Biology from the University of Colorado in 2009 and her bachelor's degree in Integrative Biology from UC-Berkeley in 2001. Her post-doc work was at the National Center for Atmospheric Research in Boulder, Colo., and she spent two years at UC-Berkeley as a plant ecophysiologist.

At MSU, Hu splits her time between teaching, research and service and currently advises two graduate students, Justin Martin and Nate Looker. She is collaborating with Kelsey Jensco at the University of Montana, looking at plant response to climate change at the Lubrecht Experimental Forest. She is also beginning collaborations with Lisa Rew and Eric Lenhoff at MSU to study cheatgrass invasion following fires, and is collaborating with a colleague at the University of Arizona, researching how to use oxygen isotopes to partition ecosystem water flux.

As a faculty member, Hu will teach undergraduate Principles of Biology and a graduate-level plant ecophysiology course. She is also developing a new upper-division undergraduate course called "Ecosystem Response to Climate Change."

As a fellow of the Institute on Ecosystems, Hu received incubation funding for her ecohydrology research and has worked with the outreach team to develop a broader impacts plan for a research proposal. Hu added that she is looking forward to collaborating with the newly hired IoE faculty members.

RESEARCHERS **CONNECT WITH STAKEHOLDERS AT IOE** SUMMIT

Collaboration and integration were the themes at the first annual Montana EPSCoR/Institute on Ecosystems Science Summit held in Helena on August 22–23, 2013. Under the direction of MT EPSCoR Project Director, Dr. Ragan Callaway, and Institute on Ecosystems Co-Directors, Dr. Ric Hauer and Dr. Cathy Whitlock, more than 120 faculty, graduate students, undergraduate students and professionals attended this meeting. Montana EPSCoR also welcomed Dr. Neil Moisey from the Montana Office of the Commissioner of Higher Education and Dr. Siân Mooney of the National Science Foundation EPSCoR office.

Participants heard about research and outreach initiatives of the Montana Institute on Ecosystems (IoE). Funded by the NSF EPSCoR program, the IoE is a community of scholars with a shared vision to advance the study of ecosystems and the effects on Montana's landscapes of a changing climate. MSU President Waded Cruzado and UM President Royce Engstrom welcomed the group, describing their own personal connections to the EPSCoR program. President Engstrom shared his experience as a new faculty member at the University of South Dakota where he eventually became director of the state EPSCoR program. Comparing the EPSCoR program to the land-grant university mission, President Cruzado stressed the impact that EPSCoR can have on educating citizens for a brighter future.

The Summit included presentations on each of the Research Focus Areas that are central to the work of the IoE. The three Research Focus Areas are studying the impact of climate change on the sustainability of healthy ecosystems in Montana. Similarly, the outreach, workforce development, cyberinfrastructure, and diversity teams of the IoE had the opportunity to share their work in disseminating the research results and engaging Montanans on topics concerning the state's vulnerability to climate change. The goal of the IoE is to increase integration of the project components and institutions.

Participants also took advantage of less structured times to hear about each others' work through the poster session which included more than 50 student and faculty posters, and roundtable discussions on strategies for integration. The conference concluded with a keynote address by Dr. Hank Loescher of the National Ecological Observatory Network (NEON). As one participant said, "…It was a great learning experience and made me think of what I can do in the future to expand my knowledge." This annual Summit will be a regular part of EPSCoR and IoE activities, as a way of bringing scientists, students, and practitioners in environmental fields together.

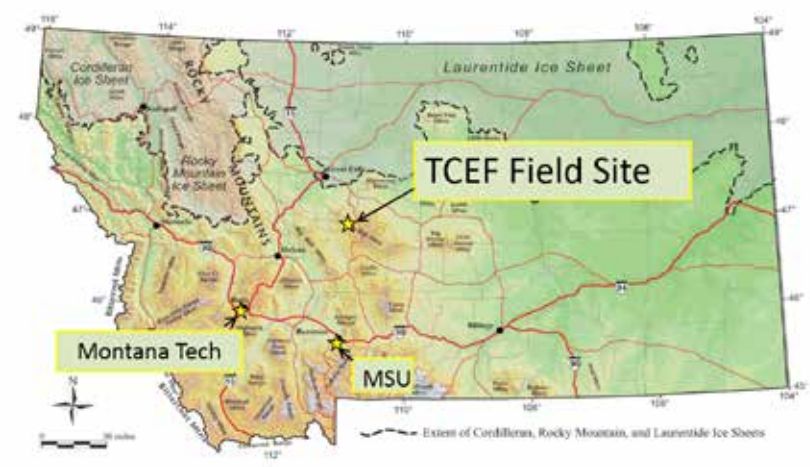
ABOVE: UM President Royce Engstrom, NSF EPSCoR program officer Siân Mooney and MSU President Waded Cruzado.

SOIL MICROBES **OFFER CLUES TO GREENHOUSE GAS FLUCTUATIONS**

Sometimes clues to something as large as ecosystem change can be found in things as small as microbes or molecules. IoE researchers Drs. Tim McDermott, John Dore and Ryan Jones, and undergraduate researcher Keenan Brame at MSU, along with Dr. Chris Gammons and undergraduate researcher Capri Gillam at Montana Tech, look for such clues by asking the question: "How do point measurements of trace gases fluxes scale up to whole-landscape fluxes?"

One gas of particular interest to this group is methane, a potent greenhouse gas. Scientists know that specific microbes produce and consume methane, and are important to the cycling of methane in soil. A better understanding of how these particular soil microbes "make a living" could help us to predict changes in greenhouse gas levels and the flows of carbon through various landscapes and ecosystems at a larger scale.

One of the team's objectives is to quantify the net fluxes of methane into and out of upland forest landscapes; another is to better understand the biogeochemical processes that drive these fluxes. According to researcher John Dore, "It is widely recognized that forests produce vital oxygen and take up harmful carbon dioxide from the atmosphere – but the beneficial role of our forests in scrubbing methane from the air remains largely unappreciated." Intense field activities for this work are being conducted at the Tenderfoot Creek Experimental Forest (TCEF) in central Montana. The MSU team is measuring the dynamics of soil methane at TCEF with high-tech instrumentation and studying the ecology of methane-cycling microbes in the forest soils, using analyses of their DNA to map their relative abundances. These efforts are linked to those of the Montana Tech group and researchers from Duke University, North Carolina State University and the University of North Carolina, Chapel Hill, who are providing information on the chemistry and stable isotope composition of soil water and shallow groundwater at the same locations where gas dynamics and soil microbiology are being examined. Together, these approaches provide a holistic picture of what is occurring regarding microbial activity and gas flux at a particular location. When scaled up, this information can help us to understand the larger picture of greenhouse gas production and fate within landscapes that are important to Montana. The data generated by this interdisciplinary research group illustrate an important linkage between methane-consuming bacteria and soil moisture. A first paper that summarizes this, and other interesting observations, is currently being written.



ABOVE: Faculty and students set up monitoring stations at the Tenderfoot Creek site.

RIVER COMPLEXITY **STUDY ADDRESSES EFFECTS OF FLOODPLAIN SIMPLIFICATION**

Floodplains are complicated environments. Unraveling the implications of this 'biophysical complexity' is the focus of a joint research project funded by MT EPSCoR/IoE under the supervision of Dr. H. Maurice Valett at the University of Montana's (UM) Division of Biological Science. Fellow UM faculty members, Dr. F. Richard Hauer, and Dr. Marc Peipoch (IoE post-doctoral fellow from The University of Barcelona), are working with Valett to use airborne surveys of geomorphic and vegetative form to quantify 'complexity' across the floodplains of select Montana rivers. The goal is to understand how floodplain complexity relates to variability in heat content, river bottom greenness, and water chemistry in channel and off-channel environments. The selected rivers span Montana's sentinel landscapes (Crown of the Continent, Upper Missouri, Greater Yellowstone, High Plains) and will include various degrees of human influences on flow (e.g., impoundments, diversions) and floodplain structure (e.g., agriculture, channel modification). In this way, Valett and his team will be able to address how human 'simplification' of floodplains alters critical biota and the processes they execute.

In a related project, Valett has formed a team of ecologists (Drs. Cara Nelson, Ragan Callaway) and social scientists (Drs. Libby Metcalf, Lauri Yung, Jakki Mohr) to pursue investigation of ecological restoration of floodplains as part of a Coupled Human and Natural Systems (CHaNS) initiative. The social scientists, led by Dr. Mohr, have used EPSCoR funding during Summer 2013 to carry out interviews with representative stakeholders involved in restoration along the Upper Clark Fork River (UCFR) in association with large-scale restoration efforts underway by Montana's Department of Environmental Quality. The team's goals are to understand how complexity of social and natural networks influences the success of restoration and the potential for partnering for scientific assessment.

Prior EPSCoR-supported work by Valett, Hauer and Dr. Jack Stanford of the Flathead Biological Station was recently published in the journal *Ecosystems* suggesting a new perspective on alluvial aquifers that argues for recognition of floodplain complexity and its influences on local and routing controls over water chemistry.

ABOVE: Research team surveying aquatic environmental quality of the Upper Clark Fork River near Drummond, MT.
–Thanks to Mike Morse for floodplain access.

ROUGH CUT **SEMINARS GET SCIENTISTS** TALKING

In the IoE-sponsored "Rough Cut" seminar series, Montana's environmental and ecosystem sciences faculty discuss current research, explore "rough cut" ideas for future interdisciplinary activities and socialize with the IoE community of scholars. Each speaker gives a seminar at UM on Monday and at MSU on Wednesday of the same week. The MSU-based seminars are broadcast live.

Fall 2013 lectures will feature topics including Methane in the Mountains (Tim McDermott, MSU) and Honey Bee Pathogen and Pathway Discovery (Michelle Flenniken, MSU). The next speaker in the fall series will be Katrina Mullan, a new IoE hire and assistant professor in the Department of Economics at the University of Montana who studies the impacts of forest conservation policies on the livelihoods of rural households.

KATRINA MULLAN
The Price of our Vanishing Forests: A Spatial Hedonic Study of Ecosystem Services in the Brazilian Amazon

— Mon. Sept. 30 – 12:00 pm
330 University Center UM
— Wed. Oct. 2 – 12:00 pm
126 EPS MSU

For a full schedule of Rough Cut Seminars, Distinguished Visiting Lecturers and other IoE events, visit: montanaioe.org/events

View recordings of last year's Rough Cut Series at: montanaioe.org/outreach/videos

TOP: (L to R) Missoula Mayor John Engen (blue shirt), spectrUM Director Holly Truitt and UM President Royce Engstrom celebrate the ribbon cutting. ABOVE: Children enjoy the exhibits in spectrUM Downtown.

SPECTR**UM** DISCOVERY AREA DOWNTOWN **OPENS**

IOE AND MISSOULA COMMUNITY CELEBRATE OPENING OF THE SPECTRUM DISCOVERY AREA

Hundreds of community members gathered to celebrate the grand opening of the spectrUM Discovery Area Downtown on August 23, 2013. Joined by Mayor John Engen, University of Montana President Royce Engstrom, and dozens of UM researchers and faculty, spectrUM opened its new Front Street museum with the help of 318 community members wielding scissors donated for the event.

As a vital part of the University of Montana, spectrUM inspires a culture of learning and discovery for all Montanans, with the ultimate goal of motivating K-12 students to pursue higher education and possibly careers in STEM fields. Dedicated to closing achievement gaps in science, technology, engineering, and mathematics (STEM), spectrUM shares hands-on science with 39,000 people annually through in-museum public hours, field trips, clubs, and camps.

The museum's grand opening in the Maya Building marshaled the full resources of the Missoula and UM communities. Before families and supporters sliced through the giant pink ribbon, Mayor Engen, President Engstrom, and spectrUM Director Holly Truitt shared their gratitude and excitement about the new space.

Truitt said, "The grand opening shows that it truly takes a community to build and sustain a museum like ours." In recognition of the museum's location on historically Native American land, as well as of spectrUM's outreach in communities across Montana's Indian Country, Tony Incashola, director of the Salish Pend d'Oreille Culture Committee, offered a blessing. Guests explored the museum's new exhibits while being serenaded by the All City Band's tuba ensemble and munching cookies donated by Missoula bakeries and restaurants.

In partnership with IoE and EPSCoR, the museum features a Large-River Ecosystems exhibit that makes use of the Clark Fork River just beyond the museum walls. The exhibit showcases a water table modeled on Missoula's portion of the Clark Fork, with local icons like Mount Sentinel and Mount Jumbo, UM's clock tower, as well as portholes into the rivers subsurface, dam tabs, Brennan's wave (the ultimate riffle), and dancing trout. An erosion table allows visitors to create their own virtual floodplain and learn what happens when they manipulate the landscape. Through a live osprey webcam, a flight simulator, and digital learning opportunities featuring iPads, GIS, and GPS units, visitors learn about active research by IoE faculty such as professors Ric Hauer, Kelly Dixon, Maury Valett, Joseph Shaw, Andrew Wilcox, and their graduate and undergraduate students.

spectrUM Downtown is located at 218 Front Street in downtown Missoula and is open to the public Tues.–Sun., 10–5 pm. Additional information about spectrUM's exhibits and programming can be found at **spectrum.umt.edu.**

CLIMATE IN MY BACKYARD **SUMMER CAMP SESSION IMMERSES KIDS GRADES 5–7 IN CLIMATE AND ECOSYSTEM SCIENCE**

Whether you ski, float, farm or fish, the climate affects you and your ecosystem – from microbes to entire watersheds. That was the main message conveyed to participants in the June 2013 IoE session of Montana State University's weeklong Peaks & Potentials camp for high ability kids entering grades 5, 6 and 7. During the session, five university researchers led the youth in hands-on activities and discussions that mimicked the types of research that they conduct.

Learning objectives for the students were to describe what affects and changes ecosystems, to demonstrate an understanding of how scientists study climate change, and to understand how climate change can impact Montana's ecosystems.

Dr. Tony Hartshorn, assistant professor in MSU's Land Resources and Environmental Science (LRES) department, described the carbon cycle and greenhouse gases and took the students on a field trip to Towne's Harvest garden to see his carbon dioxide sampling robots. He led them in an experiment to investigate what conditions increase carbon dioxide release from soils.

Shavonn Whiten, MSU graduate student in the LRES Department and a member of Robert Peterson's lab, discussed mosquitoes as vectors for infectious diseases and their potential responses to climate change. She was assisted by MSU undergraduate Hannah Bares.

Erica Garroutte, MSU graduate student in the Ecology department and a member of Andy Hansen's lab, led the students in activities relating to phenology (the timing of natural events such as the green-up of vegetation) and how it may impact elk as climate changes.

Dan Vanderpool, UM graduate student in the Division of Biological Sciences and a member of John McCutcheon's lab, and Ryan Bracewell, UM graduate student in the College of Forestry and Conservation and a member of Diana Six's lab, led the students in an investigation of pine beetles, the fungus they eat, and their role in Montana's ecosystems.

QUICK FACTS

- Ten children attended (7 from Bozeman, 1 from Livingston, 1 from Deer Lodge and 1 from Billings)
- Each child received 7.5 instruction hours
- Five IoE affiliated researchers participated (3 from MSU, 2 from UM)
- Evaluation demonstrated that the youth unanimously rated the sessions as educational and enjoyable. They also indicated that they were more informed about the topics addressed and were motivated to learn more about the topics.
- Students improved their scores on a pre/post questionnaire about climate-related questions by 25%.

Researchers who would like to participate in the 2014 Peaks & Potentials camp can contact Jamie Cornish at jcornish@montana.edu.

ABOVE: Dan Vanderpool guides students in detecting signs of pine beetles in samples of wood. BELOW: Students received waterproof field journals to document their notes and data—here a student sketches and labels the parts of an insect.

MEET YOUR ECOSYSTEM

MSU freshmen learn about the Yellowstone ecosystem while building a sense of place

IoE faculty member Dave McWethy helped lead a group of incoming MSU freshmen through Yellowstone National Park in late August. The group examined physical, biological and social aspects of the Yellowstone ecosystem while forging bonds with faculty and other new students. The program is called 'Mountains and Minds' First Year Engagement Initiative: Building a Sense of Place Through Discovery in the Greater Yellowstone GeoEcosystem.'

ACCELERATED MATH PROGRAM PREPS **NATIVE AMERICAN STUDENTS** FOR COLLEGE CALCULUS

EPSCoR's Accelerated Math Program shows potential to reduce the barrier that calculus imposes on students with limited access to strong math preparation.

As participants in the EPSCoR Accelerated Math Program, 19 Native American students spent their summer doing an unusual full-time job: studying calculus. The six-week program targets rising high school juniors, seniors and entering college freshman who aspire to pursue degrees that require calculus.

The project is the brainchild of Sara Young, tribal college liaison for EPSCoR. Young noted that math preparation is one of the most significant barriers for students entering a science or engineering field, and that Native American students coming from reservation schools are further challenged by the fact that their school may not have offered calculus.

At Montana State University, the number of Native American students entering calculus as freshmen has averaged only 10 per year since 2003. Among these students, the average final grade in calculus was never higher than a C+ and the overall average was closer to a C-.

The Accelerated Math Program designed to address this issue was implemented at three Montana tribal colleges: Stone Child College, Little Big Horn College, and Fort Peck Community College.

Students start the program with a baseline assessment of their math skills. They visit the MSU campus during their first week, attending college calculus and pre-calculus classes to get an idea of the pace and content in the courses. During the program, they study math for eight hours a day, with three fitness breaks to keep their minds active and engaged. The instructors, who are tribal college faculty, supplement traditional teaching methods with iPads and math apps which familiarize students with resources they can access outside the classroom. Many of the students report that having this tool—and learning how to direct their own instruction—was one of the most valuable aspects of the program.

This year, of the 19 students who started the program, six tested into calculus at the end and four into pre-calculus. All students showed a significant increase in their placement level, with some increasing four levels. One student who planned to attend college in the fall retook his placement test and placed into calculus rather than pre-calculus. Another student reported that he was invited to become a math major after doing so well his first semester.

At the end of the six weeks, students who completed the program without more than three absences got to keep the iPad they used during class. Many said that this became an invaluable tool for them during the school year.

To see a video about the Accelerated Math Program, visit: http://youtu.be/x9f_-njezPw

ABOVE: Students at Stone Child College work on math problems with instructor Cory Raeth (right).

INTERDISCIPLINARY NETWORK **HELPS RESEARCHERS COLLABORATE**

For specialists in any field, the ability to share expertise and knowledge is a key to increasing efficiency and enhancing outcomes. Yet, sharing information and resources across a large and geographically dispersed research community can be challenging. The Interdisciplinary Collaborative Network (ICN) was founded to tackle this challenge.

University of Montana graduate student Mandy Slate rallied her colleagues to come together and develop a way to share resources, expertise and interests. A second year PhD student in Organismal Biology and Ecology, Slate realized that effective scientific research involves collaboration across disciplines, which sometimes requires a nudge to get started.

The ICN provides a mechanism through which individuals in disparate fields or geographic locales can easily find opportunities to contribute to research on the same system or concept.

ICN connects researchers from varying professional levels, universities and disciplines within the Montana University System, with the goal of integrating research and disciplines across the state.

According to Slate, it has already made a difference. "The enthusiasm with which people are encountering the project as a whole has been inspiring. By facilitating new relationships we are fostering opportunities for collaborative research to develop organically."

With seed funding from MT EPSCoR, the ICN established a website and held its first member retreat in Glacier National Park in August 2013.

A calendar of events and other outreach opportunities can be found at ***http://interdisciplinarycollaborativenetwork.org.*** For more information, and to join the network, email ***interdisciplinecollab.um@gmail.com***

LEFT: The ICN committee at a retreat in Glacier National Park.