MONTANA NSF EPSCoR

Summer 2014

Montana University System STEM research and education news

IoE IS COVER STORY FOR TOP UNIVERSITY PUBLICATIONS

Montana NSF EPSCoR's flagship research program, the Montana Institute on Ecosystems, was the cover story for two top university publications this spring: ResearchView (UM) and Mountains & Minds (MSU).

ResearchView emphasized IoE's unique position as a statewide entity that can serve as a model for the rest of the country.

"Other environmental centers around the nation are based at a single institution, but the IoE employs the resources of the entire Montana University System to achieve its goals," stated the article. "It's a new statewide model for research centers, and Montana is leading the way."

The cover article also quotes IoE co-director **Ric Hauer**: "Our work encompasses a wide spectrum of research, from the natural sciences all the way to the cultural, human end of how people interact with their environment. The IoE truly enhances science across the entire state."

The entire publication is devoted to IoE research at UM, featuring **John McCutcheon** and **Diana Six**'s ground breaking work on pine beetles, **Andrew Wilcox** and **Marco Maneta**'s efforts to model hydrological systems under a changing climate, **Maury Valett**'s goal to bring new science to river restoration, and the innovative student-led Interdisciplinary Collaborative Network.


Spring 2014

The Montana State University Magazine

MOUNTAINS & MINDS

Log in

Ring of fire by Sepp Jannotta • Published 04/29/14

An international team led by MSU scientists is putting the past, present and future of wildfire into global perspective

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During the summer of 1988, with much of the United States experiencing serious drought, and discussions swirling about the global environmental toll of greenhouse gases, persistently dry and windy conditions in the West combined to produce the most expensive wildfire event the U.S. had ever seen.

Before it was over, 51 individual wildfires combined to torch nearly 800,000 acres, or 36 percent, of Yellowstone National Park, roughly the size of Rhode Island. In a single August day, wind-fanned flames consumed 150,000 acres, including lands outside the park, the fires burned 1.2 million acres of forest. The months-long battle brought 25,000 federal firefighters onto the fire lines and cost $120 million. Smoke from wildfires in and around Yellowstone darkened the sky up and down the Rockies and far and wide across the Great Plains.

It was a year that seared wildfire and the government response to wildfire into the national consciousness.

A quarter of a century after the touchstone events of 1988, the American West has seen a dramatic increase in large wildfires tied to drought and a warming climate. In Australia, where warming has produced catastrophic wildfires that seem as seasonal an occurrence as monsoonal rains, the press has taken up a new term: "megafires."

The Spring issue of MSU's Mountains & Minds features a stunning wildfire cover photo that leads into IoE co-director **Cathy Whitlock**'s wildfire research, noting its genesis and evolution following the 1988 fires in Yellowstone.

"During 20-plus years of exploration into the paleoecology of Yellowstone, Whitlock has pioneered many of the techniques used for delving into a landscape's history to better understand the role of wildfire in an ecosystem," author Sepp Jannotta wrote.


RESEARCH VIEW

UNIVERSITY OF MONTANA

Spring 2014

Research, Innovation & Imagination

A New Kind of Institute

It's like nothing else in the United States.

The Montana Institute on Ecosystems studies the large landscapes and riverscapes of Big Sky Country and how they will be affected by environmental change, whether that change is in land use, climate or our forests, grasslands or water. Other environmental centers around the nation are based at a single institution, but the IoE employs the resources of the entire Montana University System to achieve its goals. It's a new statewide model for research centers, and Montana is leading the way.

Formed in 2011, the institute is co-directed by Professors Ric Hauer of the University of Montana and Cathy Whitlock of Montana State University. Its start-up funding is from a five-year, $20 million grant from the National Science Foundation's Experimental Program to Stimulate Competitive Research, as well as a $4 million state match.

More than 250 faculty members from across Montana, including those at tribal and two-year colleges, are IoE affiliates. Their research covers everything from the changing hydrologic regimes of floodplains to environmental policy and law. "Our work encompasses a wide spectrum of research, from the natural sciences all the way to the cultural, human end of how people interact with their environment," Hauer says. "This special edition of Research View will offer a taste of what we do here at UM, but the IoE truly enhances science across the entire state."

The institute offers research and internship opportunities to undergraduate and graduate students. Fellowships and stipends are available to attract the best and brightest graduate students to Montana. The IoE also works to foster interdisciplinary research, creating connections among researchers across campus and between campuses. In addition, it works to ensure scientists have the proper cyberinfrastructure to compete with the rest of the world.

"How do we respond to environmental change so that it leads to economic and lifestyle sustainability for the state of Montana?" Hauer asks. "That is the big question for the Institute on Ecosystems." a

(Top) A UM graduate student approaches a research station in the Bitterroot Mountains. (Below) UM hydrology Professor Marco Maneta studies the effectiveness of snow-measuring technology.

Got Snow?

UM studies accuracy of measuring instruments

If snow falls on the mountain and no one is around to measure it, how much does it snow? That's the question UM hydrology Assistant Professor Marco Maneta seeks to answer.

"We've been working in hydrology for a long, long time," Maneta says. "but we still do not have an accurate way of measuring the total volume of precipitation in our mountains."

That might sound surprising. In Montana, eager skiers look up the daily snowfall report. In summer, irrigators and river rafters check river flows. Each day, the weather report tells us how much rain or snow to expect. Our lives so much of livelihoods and recreation depend on water. In an era of climate change, drought and warming winters, Westerners are paying close attention to this finite resource.

Beetle With Benefits p. 2 • Clark Fork Collaboration p. 4 • Connecting Campuses p. 7

Snow – continued page 6

"Fires are an ecological concern, but they are also a question of human health and safety...and we think it is one of the most important areas of climate change research that needs attention," Whitlock said in the article. The article also highlights the work of MSU IoE faculty **Dave McWethy** and **Bruce Maxwell**.

Read Research View at http://www.umt.edu/urelations/pubs/Research%20View/Spring%202014/default.php

UM partnership with Army Corps brings $45M to Montana

The University of Montana has received a five-year $45 million cooperative agreement award from the **U.S. Army Corps of Engineers**, the largest research award in UM's history. The project is a direct outcome of the NSF EPSCoR-supported Montana Institute on Ecosystems and Dr. Ric Hauer's long-standing relationship with the Army Corps of Engineers. The project will involve the UM, the Montana University System and the IoE in helping the Corps study and solve environmental and cultural resource problems across the nation.

UM will also assist the Corps in implementing land and water ecological restoration, maintenance and training for optimal management of public resources. F. Richard "Ric" Hauer is UM professor of freshwater science and systems ecology and directs the UM side of the IoE. He will serve as program director and principal investigator of the cooperative agreement.

"Earning this award confirms that UM has become an elite research institution in the arena of ecology and environmental sciences," Hauer said. "This will take our research enterprise to an even higher and exciting new level. It is a wonderful opportunity for our faculty, graduate students and post-docs."

continued on back page

Montana NSF EPSCoR

The Experimental Program to Stimulate Competitive Research (EPSCoR) is a National Science Foundation program to advance science and engineering capabilities for discovery, innovation and overall knowledge-based prosperity. EPSCoR catalyzes key research themes, activates effective collaborations, broadens STEM participation, and drives programmatic experiments that motivate positive change and progression. Montana EPSCoR's flagship research program is the Institute on Ecosystems (IoE), a statewide, university system-led effort dedicated to understanding the effects of climate change on sustaining healthy ecosystems and economic growth.

http://www.nsf.gov/od/iia/programs/epscor/

UPCOMING **EVENTS**

June 30–July 2. Data Intensive Summer School workshop, MSU. Develop skills needed to manage, process and gain insight from large amounts of data. Designed for researchers from the physical, biological, economic and social sciences.

July 8. Bozeman."Climate Change & National Security: People not Polar Bears" Public talk by Rear Admiral (ret.) David Titley. Open to the public.

Sept. 15, Midway, Utah. MTNCLIM 2014 Mountain Climate Research Conference. Sponsored by the Consortium for Integrated Climate Research on Western Mountains (CIRMOUNT), and dedicated to mountain climate sciences and effects of climate variability on ecosystems, natural resources, and conservation in western North American mountains.

Oct. 6, Mammoth Hot Springs, YNP. 12th Biennial Science Conference on the Greater Yellowstone Ecosystem. Crossing Boundaries -- Science, Management & Conservation in the Greater Yellowstone. This conference series has become the foremost scientific venue for researchers and management partners with a shared interest in understanding the geologic, cultural, and biological resources of the region.

Fall 2014: Watch for a schedule of **Rough Cut Science** talks that will be broadcast online each Wednesday noon.

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This material is based on work supported by the National Science Foundation under Grant EPS-1101342. Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

PEOPLE IN THE IOE

MSU EARTH SCIENCES DEPARTMENT HIRES THREE NEW FEMALE FACULTY MEMBERS

The hiring of three new tenure-track faculty members has increased the total number of women in tenure track positions in the MSU Department of Earth Sciences by 300%. Prior to these new Montana EPSCoR-supported hires, the department had only one tenured female faculty member, MSU IoE Dr. Director **Cathy Whitlock**.

In additional to adding demographic diversity to the department, the new hires also add disciplinary diversity to the department. Two of the three faculty are resource geographers, Drs. **Julia Haggerty** and **Jamie McEvoy,** who provide an interdisciplinary approach to integrating social science into research on natural resource management. The third, Dr. **Jean Dixon**, provides expertise in geomorphology. These new hires will support IoE objectives and expand the capacity of researchers in Montana to engage in interdisciplinary research.

The new hires are supported, in part, by funding from EPSCoR.

Left to right: Jia Hu (Ecology), Jean Dixon (Earth Sciences), Rob Payn (LRES), Cathy Whitlock (Earth Sciences, IoE co-director), Jamie McEvoy (Earth Sciences), Julia Haggerty (Earth Sciences).

STUDENT CONDUCTS ECOSYSTEM FELLOWSHIP WITH CHIEF DULL KNIFE COLLEGE

Patrick Lawrence, a graduate student in Land Resources and Environmental Sciences at MSU, has earned a six-month fellowship to conduct ecosystem-oriented teaching and research at **Chief Dull Knife College** on the **Northern Cheyenne Indian Reservation.**

Lawrence's research focuses on the resilience of large-scale dryland ecosystems to economic and climatic change. On the Northern Cheyenne Reservation, Lawrence hopes to work with CDKC students and local community members on agricultural and ecosystem-related mapping activities that help community members make decisions about land use and agricultural production. Lawrence will also help to facilitate outreach projects in which CDKC students present research results to junior and high school students in **Lame Deer**.

"The food system (on the Northern Cheyenne Reservation) is highly vulnerable in terms of individual food insecurity and reliance on food products whose prices fluctuate wildly," said Lawrence. Lawrence plans to work with students and community members to study areas on the reservation where crops and vegetables could be grown, thus increasing local food production and providing better access to nutritious and affordable products. Using GIS software, the team will make recommendations based on access to productive soils, irrigation and other factors. The project will involve water quality sampling, vegetation health assessments, inventorying local plants and teaching laboratory skills.

Patrick Lawrence

Lawrence said participating CDKC students may also choose to interview tribal elders and find historical references and stories that indicate which crops the Northern Cheyenne grew in the past.

IoE undergrads begin environmental research projects across Montana

Seventeen Montana University System undergraduates and one student from Salish Kootenai College have received summer internships to research environmental and climate change-related projects at sites throughout Montana. The students, all part of the Montana IoE, will work with faculty at MSU, UM and Montana Tech on a variety of projects, studying everything from cheatgrass and Douglas fir trees to the influence of wildfire and fire history, along with honey bees, cicadas and westslope cutthroat trout.

IoE's internship program supports students exploring the effects of climate change in sustaining healthy ecosystems and economic growth. The students' research findings will be presented at the undergraduate research symposium in Bozeman on Aug. 6. Students will also use Twitter to communicate about their research this summer. Follow **@MTIoE** and **#ioesummer.**

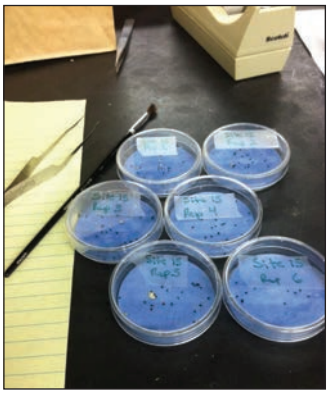
Interns, their hometowns, research topics and project location are:

Frances Ambrose, Nashville, Tenn.: Understanding the influence of wildfire on the vegetation patters of the Greater Yellowstone Ecosystem. Greater Yellowstone area.

Sara Amish, Hamilton, MT: Climate change impacts on water use and forest productivity. Lubrecht Experimental Forest.

Erik Anderson, Helena, MT: Using water isotopes to link water and solute movement in cultivated and uncultivated soils. Judith Basin.

Noelani Boise, Livingston, MT: Assessing the effect of change in temperature and precipitation on a cheatgrass-invaded rangeland. Red Bluff Research Ranch, Norris.



Chance Noffsinger and Noelani Boise count Linaria seed for a temperature germination test related to cheatgrass research. Photo by Chance Noffsinger.

Bennett Bursick, Bellingham, Wash.: Effects of wildfire on terrestrial subsidies to the westslope cutthroat trout diets in the Bitterroot River Basin. Bitterroot River basin.

Kaitlin Carey, Bozeman, MT: Genome analysis: Evolution of symbiotic bacteria inside the gut of sap feeding insects. MSU.

Lindsay Gray Carlson, Kalispell, MT: A comparison of soil quality and composition effects on plant understory regeneration after wildfire events in Glacier National Park and the Bob Marshall Wilderness.

Kevin Carns, Ellensburg, Wash.: Variability in riparian ecosystem composition and structure. Five streams in southwest Montana.

Hannah Funke, Polson, MT: Reconstructing the fire history of the Flathead Indian Reservation. Mission Mountains outside Polson.

Fletcher Harvey, Gallatin Gateway, MT: Identifying connections between landscape patterns and whitebark pine mortality. Helena National Forest.

Greta Hoffman, Helena, MT: How wildfire affects plant-pollinator interactions across Montana. Glacier National Park.

Jared Hoy, Helena, MT: Tracking greenhouse gas emissions in Montana. MSU.

Tyler Kelly, Dillon, MT: The effects of stress on mountain plover nesting success. UM.

Madison Martin, Laurel, MT: Identification of metabolic signatures of pathogen and pesticide stress in honey bees. MSU.

Jennifer Nelson, Juneau, Alaska: Comparing post and pre-fledging success in mountain bluebirds (*Sialia currucoids*) with distance between nest boxes and tree stands. West of Ronan on a bluebird trail.

Chance Noffsinger, Whitefish, MT: The response of an invasive annual and native perennial grass to different climate and nitrogen scenarios. MSU.

Sam Pannoni, Babb, MT: Using 16S rRNA genes to define biomarkers within the elk (*C. elaphus*) fecal microbiome to inform individual and population health metrics. UM.

Greta Robison, Bozeman, MT: Using the special sciences and participatory learning to explore tribal data storage and impacts of climate change on water runoff on the Apsaalooke Reservation. Lodge Grass, Crow Agency.

Story Lab: Scientists, journalists come together to advance environmental reporting

Scientists and journalism faculty from the UM Master's Program for Environmental Science and Natural Resource Journalism organized a "Story Lab" retreat to enhance communication between conservationists, scientists and journalists. The event was held at Boone and Crockett Club's Theodore Roosevelt Memorial Ranch on the Rocky Mountain Front near Dupuyer, Montana on April 18-20. A key objective was to learn how journalists develop and report science stories; how scientific research might inform storytelling about large-landscape conservation; how journalists, scientists and conservationists communicate with the public and each other; how they understand their respective roles in informing the public, and what challenges face communities and ecosystems in the Crown of the Continent.

The Story Lab Retreat rallied participants around a common purpose – to overcome barriers to communication about stories that examine environmental science and natural resource issues in a region that serves as a laboratory for conservation and climate resilience solutions sought all over the world.

The retreat offered scientists, conservationists and journalists multiple opportunities to get to know each other and learn about differences in their approach to communication. Participants seized those opportunities, using them to build trust, express grievances, examine their own postures and overcome barriers to cooperation.

UM Professors Henriette Lowisch, Alison Perkins and Nadia White organized a retreat for scientists, conservationists and journalists.

Over the course of two days, they increasingly appreciated to learn how "the other side" operates. Many considered the presentation by the guest speaker, science journalist Hillary Rosner, and the subsequent story brainstorming session the highlights of the retreat. Participants who had been skeptical at the outset left fired up, vowing to seek opportunities to better connect science and journalism.

Building River Restoration Capacity

Natural and social scientists at the UM have launched a collaborative project focused on understanding the factors that influence river restoration. Through the use of systems theory, the team has critically examined ecological, social, and business dimensions of restoration in the context of the Clark Fork River in Montana. This comprehensive examination has identified drivers of restoration success that contribute to our understanding of restoration capacity.

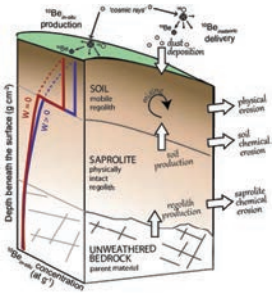
Ecological restoration—assisting in the recovery of ecosystems that have been degraded, damaged, or destroyed—has become a dominant natural resource management activity. Much of the science associated with restoration has been ecologically focused. Only recently has there been a call for understanding the social dimensions of restoration. An exploratory study was conducted using 40 field-based interviews with stakeholders throughout the Clark Fork River corridor.

Based on these interviews, three key foundational elements of the social-ecological system were identified: complexity, information capital and collaborative communication. Findings have helped develop an integrated system that combines ecological and sociological drivers of restoration success and build the foundation for 'restoration capacity.' Additionally, results from this study have informed an NSF proposal and a conference presentation, are being developed into a manuscript for publication, and have been integrated into curricula in UM's Ecological Restoration undergraduate program.

New MSU labs are at the cutting edge of chemical and physical measurements

Two new facilities at MSU—a gamma-spectroscopy lab and cosmogenic-radionuclide (CRN) preparation facility—allow measurement of novel isotopes on chemical and physical processes that transform Earth's surface. Only a few universities in the world have the combination of these two facilities.

The labs will provide preparation and analysis facilities for novel isotopic methods to measure rates and processes of landscape change over different time scales (from instantaneous measurements to those that integrate over hundreds of thousands of years). The tools help researchers understand how soils and sediments move under forcings such as climate, changing land use or fire.



New labs allow researchers to measure erosion rates averaged over hundreds to hundreds-of-thousands of years

Archaeological discoveries indicate how humans have navigated ecological changes over time

A UM scholar, Dr. Kelly Dixon, examined archaeological investigations in the North American West that demonstrate the ways in which humans have navigated drastic socio-cultural and ecological changes over the past several centuries.

The research demonstrates how archaeology and cultural heritage inquiries have documented numerous "lessons" that are relevant to humanity's navigation of pressing social and environmental issues in urgent need of attention in the 21st century.

Dixon, a UM Anthropology Professor, wrote "Historical Archaeologies in the American West," which presents an overview of historical archaeological inquiry in the American West to demonstrate the ways in which colonialism, landscape transformation, migration, and industrial capitalism have collectively transformed the region's natural and cultural resources. The paper, published online in January 2014 in the *Journal of Archaeological Research,* will be published in print in September 2014.

As the North American West continues to experience human dilemmas related to issues such as balancing resource extraction with sustainable conservation, these archaeologies have value for transcending the nature-culture divide and understanding the ways in which humanity can navigate pressing issues relevant to our modern world, including vulnerability, risks, adaptation, resilience and sustainability.

Teams comb Flathead Indian Reservation for clues about recent and ancient fires

MSU, Salish Kootenai College and federal researchers are looking to trees, lakes and oral tradition to learn about fires in the Northern Rockies. **David McWethy,** a Montana IoE Fellow and paleoecologist in MSU's Earth Sciences Dept., is leading a team of students sampling sediments from several lakes on the Flathead Indian Reservation. **Rick Everett** of SKC, the overall project leader and a forestry professor at SKC, is leading a group of students collecting tree rings and fire scars.

The charcoal, pollen and other materials they expect to find in lake sediments will speak to the frequency and timing of ancient and recent fires. Tree rings and fire scars reveal when fires occurred, how severe they were and what the climate was like during the life of the tree. They hope the lessons learned from ancient and recent fire management will help land managers determine how management and restoration might best reduce the risk of hazardous fire activity while promoting the long-term resilience of native coniferous forests of the northern Rockies.

The team works in conjunction with the Confederated Salish & Kootenai Tribes Tribal Forestry and Cultural Resources. The project is funded by a USDA National Institute of Food and Agriculture Tribal Colleges Research Grant. Collaborators are the USDA Forest Service Rocky Mountain Research Station Fire Sciences Lab in Missoula and the U.S. Geological Survey in Bozeman.

Inter-institutional research team to study energy-water-health nexus in the Bakken

A research team comprised of one faculty member from MSU-Bozeman and two from MSU-Billings have been awarded $50,000 by Montana INBRE (IDeA Networks of Biomedical Research Excellence) for their research on The Energy-Water-Health Nexus: Assessing the Environmental Impacts and Public Health Implications of Oil and Gas Production in Richland County, Montana. The project will assess potential and existing health and water quality impacts associated with oil and gas production in the region.

The research will provide water quality data for 25 untested wells serving rural households in Richland County, an area impacted by oil and gas exploration in the Bakken Oil Formation. It also provides an initial assessment of perceptions of potential and existing health impacts related to hydraulic fracturing and establish communication between researchers, health experts, and local and state leaders in order to facilitate science-based decision making related to energy development in the region. The grant also will help support an MSU-Bozeman graduate student to assist in data collection of water quality samples and perceptions of health impacts.

Since 2000, the geographic area of the Bakken Shale Formation has experienced a boom in oil and natural gas production. Spurred by innovations in hydraulic fracturing, energy development is now a notable presence in this traditionally agricultural landscape. In Montana, Richland County is most affected.

This project aims to conduct a preliminary investigation of the potential health impacts of energy development in Richland County, especially those relating to water quality of un-tested wells serving rural households. Links between hydraulic fracturing technology, environmental contamination, and rises in sudden and abnormal health problems – headaches, diarrhea, nosebleeds, dizziness, blackouts, muscle spasms – have been reported but have yet to be systematically examined. The project proposed is a "first step" towards developing a broader, long-term, and inter-disciplinary research agenda focused on the energy-water-health nexus in a specific and important geographic context: the Bakken. The over-arching goal of the project is to investigate the relationship between existing and potential disease emergence and water quality issues connected to hydraulic fracturing in this region. This would provide important knowledge for local communities and inform public policy.

Researchers will test wells serving rural households in areas with expanded energy development. *Wikimedia Commons photo.*

IoE researchers in *Nature*: Record global land carbon uptake was driven by dryland ecosystems

Dryland ecosystems, which include deserts to dry-shrublands, play a more important role in the global carbon cycle than previously thought. In fact, they have emerged as one of its drivers, say IoE researchers in a May 2014 *Nature* article. Lead author **Ben Poulter** (MSU) and co-author **Steve Running** (UM) collaborated with researchers at 10 institutions worldwide.

The authors discovered that the largest reported land carbon sink in 2011 was due largely to changing dynamics of dryland ecosystems.

"Our study found that natural events in Australia were largely responsible for this anomaly," Poulter said. "La Nina-driven rainfall during 2010 and 2011, as well as the 30-year greening up of its deserts and other drylands, contributed to significant changes across the globe."

The authors discovered that an increase in the precipitation sensitivity of a range of ecosystems processes occurred between the periods of 1982-1996 and 1997-2011. One of those processes was the greening of desert vegetation. Together those processes led to a four-fold increase in net carbon uptake to precipitation over the past 30 years.

Surprised by the discoveries, the authors are urging global ecologists to include the emerging role of dryland ecosystems in their research.

"This study shows that although arid ecosystems like Montana don't grow very fast, they are an important part of the global carbon balance and their response to climate trends are noticeable," Running said. "These biomes occupy a huge area globally – some 17 million square miles – which is about 45 percent of the Earth's land surface."

"Novel responses of the biosphere have been predicted to occur following human activities that have caused unprecedented changes in atmospheric carbon dioxide concentrations, climate and land cover," Poulter said. "Our study provides new evidence that interactions among these human activities are now also impacting dryland biomes. These findings have global implications that should be considered in monitoring networks and earth system models."

The researchers said the large 2011 land carbon uptake is not expected to lead to long-term increases in ecosystem carbon accumulation.

This photo shows the greening of semi-arid vegetation in the Northern Territory of Australia, where increased productivity played a key role in the record 2011 global land carbon sink following prolonged La Nina rainfall and long-term changes in vegetation. Photo by Eva van Gorsel.

ICN Continues to Grow with Seminar Series and Awards for Graduate Student Researchers

By Doug Brugger, PhD student, Geosciences Department, UM

Graduate students from 13 departments and colleges from the UM, MSU and Montana Tech created the Interdisciplinary Collaborative Network (ICN) to better understand and engage in interdisciplinary research. With support from IoE, the ICN teaches graduate students the importance of interdisciplinary research and encourages them to make collaboration an integral component of their studies. Graduate students typically complete their research or professional theses independent of other students; the ICN encourages students to break this traditional mold and enrich their graduate school experience with peer-to-peer collaboration. As a result, and in combination with newly instated events, features, and programs, the ICN has seen remarkable success.

Last year, the ICN hosted social gatherings to create and strengthen friendships among graduate students from different departments, colleges and universities. The ICN's website (www.interdisciplinarycollaborative-network.org) released a directory that allows members to search and connect with one another based on research skills and interests. The site also houses a blog featuring ICN members. And, at UM in Spring 2014, the ICN launched a seminar series to address the questions and needs of graduate students. Combining discussions, faculty speakers and workshops, the seminars not only bridged gaps between disciplines but also increased graduate student exposure to and mentorship from faculty members. The seminar will continue at UM for Fall 2014, with a focus on a broad range of professional development skills, such as communicating research, writing proposals and learning the review process, and career preparation. The seminars will be available remotely for MSU and Montana Tech students.

Within the next year, the ICN will commence a new program – the Collaboration Challenge (CC) – which will support and recognize graduate students engaging in interdisciplinary collaborative projects. The program consists of a Research Grant and an Honorary Award, offered to graduate students at UM and MSU. The CC Research Grant encourages graduate students to submit proposals for studies that involve researchers from disciplines other than their own (graduate student, faculty, or otherwise). The ICN anticipates offering $1000 grants, with at least two CC Research Grants awarded per school per year. This award will fund the graduate student's project in accordance with a budget included with the proposal (i.e., the award is not a stipend). The Grant will make it feasible for students to engage in interdisciplinary collaboration as a component of their graduate research, which will enhance both the impact of the student's research and the value of their graduate education.

ICN graduate student Sharon Hood (Organismal Biology and Ecology) volunteers for a weekly shifts at spectrUM.

The CC Honorary Award will be offered as a University-sanctioned recognition of graduate students who have completed an interdisciplinary collaborative project during their graduate careers. Interested students submit an application that explains how their project brought together researchers from different disciplines to work on a common problem. Applications for both awards are reviewed by ICN members, faculty researchers and university representatives.

Upcoming programs include a Collaboration Challenge that will help students secure funds for engaging in interdisciplinary projects and an awards program to recognize interdisciplinary researchers

ICN helps make collaborations among graduate students practical and productive, and the value of the ICN is increasing exponentially with each new member (the number of possible collaborations between n ICN members is proportional to n^2!). Join the ICN by creating a member profile on the website. Send an email to interdisciplinecollab.um@gmail.com saying you would like to join the ICN and you will be given login information to get started. Information about all the programs listed above are on the ICN Website.

MONTANA STUDENTS VISIT JPL

In April 2014, three Montana students toured NASA's Jet Propulsion Laboratory with Dr. Aaron Thomas, Director of the UM Indigenous Research and STEM Education Program (IRSE). The trip was funded by the All Nations Alliance for Minority Participation Program (AMP)—a partnership between Salish Kootenai College and IRSE. AMP is funded by the National Science Foundation with the goal to increase the number of Native American students successfully completing degrees in STEM fields. AMP provides student stipends, conference travel assistance, and research opportunities to eligible AMP Scholars.

SpectrUM Discovery Area shares ecosystem science with children and families across Montana

Since the grand opening of the spectrUM Discovery Area's downtown museum in August 2013, more than 15,000 museum visitors have experienced the large river ecosystems exhibit designed in collaboration with IoE researchers.

In addition to the impact on the 15,000 visitors, high school and undergraduate students who teach at the museum are also impacted by receiving professional development training from Institute on Ecosystem faculty affiliates to better engage museum visitors with ecosystem sciences. Graduate students from the Interdisciplinary Collaborative Network serve as guest educators, connecting young learners with IoE research content.

In partnership with the Montana Institute on Ecosystems and the National Science Foundation EPSCoR Program, the SpectrUM 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, and 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. Through the museum's field-trip program, thousands of schoolchildren from the Missoula, Bitterroot, and Flathead areas learn about ongoing research in their local ecosystems.

MILITARY EXPERT TO DISCUSS CLIMATE CHANGE IN BOZEMAN ON JULY 8

David Titley, Rear Admiral (ret.) in the U.S. Navy and professor of meteorology at Penn State University, will discuss climate change as a national security issue on Tuesday, July 8 at 7 p.m. at the Museum of the Rockies.

In his talk, "Climate Change and National Security: People not Polar Bears," Titley will share his journey from what he calls a "hard-core skeptic" to climate risk expert for the Navy. He will give a plainspoken talk on the causes and consequences of climate change and will outline how climate, water, energy and food security intersect and how these issues collectively impact national security.

Titley, along with IoE faculty, will also participate in the Youth Climate Science Initiative, joining Montana teens attending the Montana 4-H Congress on field trips and workshops to learn about the impacts of climate change on agriculture and mountain ecosystems.

Dr. David Titley

Titley served as a naval officer for 32 years. While serving in the Pentagon, Titley initiated and led the Navy's Task Force on Climate Change.

Titley will provide an insider's view of how the U.S. Department of Defense and U.S. Navy's climate policy and budget have evolved over the years to address climate change. The talk will conclude with his assessment of future challenges regarding climate change, from science, policy, and political perspectives, and why he believes enough is known to take significant action now, even if not every detail about the future is known.

Montana Girls STEM Collaborative

Montana Girls STEM funds youth projects in Montana

With funding from the National Science Foundation and the Women's Foundation of Montana, the Montana Girls STEM Collaborative Project has funded eight Montana projects that are designed to engage more girls in science, technology, engineering and math. Montana Girls STEM is a signature outreach program of Montana EPSCoR and is part of the National Girls Collaborative Project, an NSF-funded effort to support the individuals and organizations that offer STEM programming for girls.

Montana Girls STEM offers professional development, best practices, mini-grant funding and collaboration opportunities to STEM educators, youth leaders, parents and teachers. The champions board includes First Lady Lisa Bullock and other government, industry and education leaders.

Mini-grant projects funded in 2014 are:

Montana Gems, an after school club in **Butte** that will also have a science fair component

Scholarships for girls to attend the **Montana Trout Unlimited Youth Conservation and Fly Fishing Camp**

SciGirls Astronomy After School Club in **Missoula**: an after-school program focused on physics and astronomy

A **STEM YouTube Channel** hosted by women in STEM created by the U. of Montana Paleontology Center and local high school girls

Hyalite STEM Club, a greenhouse/gardening/engineering program based at Hyalite Elementary School in **Bozeman**

LittleBigPlanet Club, a collaboration between Team KAIZEN Games and the Paris Gibson Museum of Art in **Great Falls** to involve girls in video game development

Reed Point STEM Club, which will engage high school girls in robotic surgery simulations

Gallatin Girls Coding Club, which will teach programming in the high-tech maker space at the **Children's Museum of Bozeman**

Sign up for Montana Girls STEM e-news at bit.ly/MontanaGirlsSTEM or follow facebook.com/MontanaGirlsSTEM. If you have a program that offers STEM programming for girls (and boys), sign up for a free listing in the online program directory at ngcproject.org/register/program

Farmer data can help reduce economic losses under drought

MSU researchers working on an NSF EPSCoR-supported project have turned to the original stewards of the land—farmers—to help them collect data about climate and ecosystem linkages.

Wheat farmers in the Northern Great Plains operate in an environment with little precipitation, high costs relative to returns, and substantial risk. The research team used sensor data collected by several farmers to understand crop responses to a variety of growing conditions and management approaches. This environmental information was combined with economic data to understand how different scenarios impacted the farmers.

The work has identified climatic conditions and fertilizer/wheat price scenarios that lead to substantial economic losses on individual farms. With this knowledge, farmers can tailor their agronomic management to respond to those risks. If the risk is substantial, they can reduce or eliminate fertilization in unresponsive areas of their farms, saving money and minimizing environmental pollution.

Take the drought in the late 1980s for example: precipitation was low and the return on harvested crops did not match the amount spent on fertilizer. The researchers identified the level of precipitation, prices, and amounts of fertilizer use that led to the loss in resilience. They then discovered that if the farmers had reduced fertilizer use in unresponsive areas of their fields, they would have had a much greater probability of avoiding bankruptcy. This method of analysis can be used to assess risk under different climatic conditions and can help farmers adjust management accordingly.

IoE researchers to study climate change impact on fish

IoE researcher Carl Yeoman (MSU) along with Gibson Gaylord (Bozeman Fish Technology Center, US Fish & Wildlife Service) and Daniel Bearden (Hollings Marine Lab, Institute of Standards and Technology, Charleston, SC) were awarded $800,000 from the USDA National Institute of Food and Agriculture (NIFA). Their project will study how climate change affects trout metabolism, thus impacting rainbow trout production. The team will examine whether modifications in fish diets or in the profile of fish gut microbes can counteract the impacts of factors such as increased water temperature and decreased water supply.

Carl Yeoman measures a rainbow trout at the Fish Technology Center outside Bozeman. Yeoman and colleagues earned an $800,000 grant to study the impacts of climate change on fish.

"Our aims are understanding how the effects of climate as well as two different dietary regiments affect gut microbial populations and metabolism," said Bearden. "Additionally, we'll study how to mitigate those negative impacts through manipulation of the microbial ecosystem or dietary manipulation or a combination."

The team will investigate low-cost dietary interventions that may enable trout production to meet the increasing demands of aquaculture in spite of forecasted climate changes.

Yeoman is an assistant professor of Animal and Range Sciences at MSU. His research exploits molecular techniques to examine the microbial ecology associated with animal systems. Yeoman said most of his work has been with mammalian systems.

"Whereas we know a lot about the human microbial ecosystem and that of other animals, we know very little about the fish gut microbial ecosystem and its contribution to health and nutrition," he said.

UM partnership with Army Corps brings $45M to Montana (cont. from p. 1)

The award confirms UM's ecological and cultural research status, said Scott Whittenburg, UM vice president for research and creative scholarship.
"When you look at a map of the United States and identify all the lead institutions doing environmental research, there should be a star next to Missoula and the UM."

During the past two decades, UM has become a world leader in conservation biology, ecology and ecosystem science, Hauer said. Recent publications in Science and Conservation Biology name UM one of five universities in the nation demonstrating the largest growth in high-impact science publications and also ranks in the top 10 among all North American universities in conservation biology and ecology.

IoE Co-director Ric Hauer (right) recently was awarded $45 million to work with the US Army Corps of Engineers on ecological restoration.